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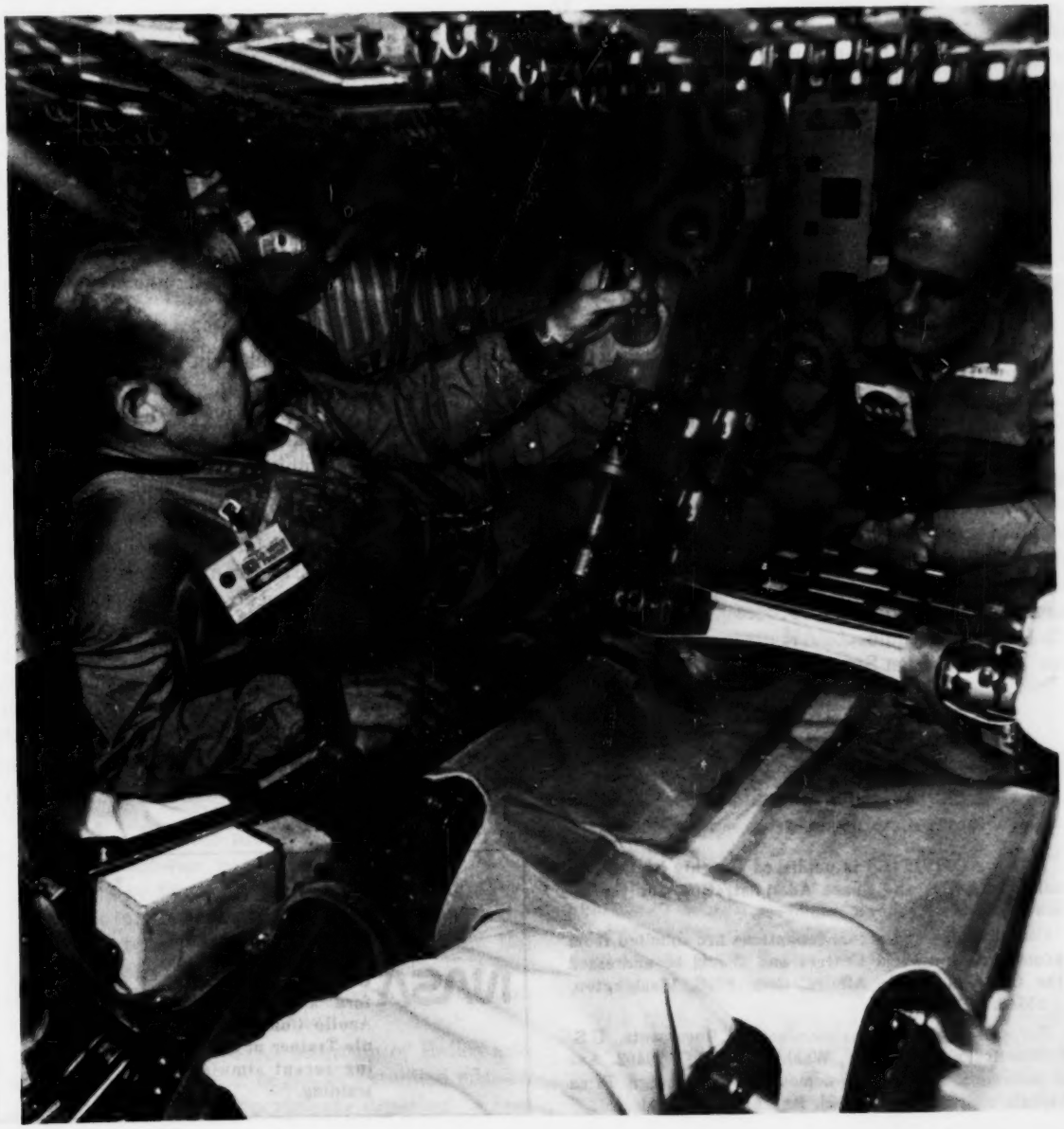

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MONTHLY NASA HIGHLIGHTS

AMATEUR RADIO SATELLITE "TALKS" TO CLASSROOMS

Thousands of radio "hams" throughout the world are tuned into their very own satellite. The AMSAT-OSCAR 7, seventh and most complex in a series of communications satellites built by an international group of amateur radio operators, was launched on Nov. 15, 1974, as a "piggyback" payload on the ITOS-G mission. Unlike most communications satellites, OSCAR is designed for free access by ground stations using relatively simple, portable equipment. OSCAR terminals can be located in automobiles, small pleasure boats, aircraft, or city apartments, and transported where needed in emergencies.

In addition to providing for amateur communications, OSCAR is being used in schools throughout the country to acquaint youngsters with space science. This is a cooperative program between NASA's Educational Programs Office and the amateur radio community. With inexpensive ground terminals, students are able to receive satellite signals firsthand in their classrooms. Systems in the satellite make it possible for the students to monitor transmissions originating from stations as far away as 5,000 miles, and to receive the spacecraft's telemetry data. Special curriculum material provided to teachers explains how OSCAR can be used to demonstrate the basic concepts of orbital mechanics, radio wave propagation and the physics of the space environment. Teachers are also in touch with licensed radio amateurs who volunteered to set up their personal radio equipment for classroom demonstrations.

COVER

ASTP Commanders, Cosmonaut Aleksey A. Leonov (left) and Astronaut Thomas P. Stafford are shown in the Apollo Command Module Trainer at JSC during recent simulation training.

The AMSAT-OSCAR 7 launch and successful operation in orbit is the culmination of four years of effort on the part of amateur groups in the U.S., Germany, Australia and Canada under the leadership of the Radio Amateur Satellite Corp. (AMSAT), a Washington, DC, based non-profit organization. Project Manager for the effort was Jan A. King, aerospace engineer with the Delta Launch Vehicle Office at the Goddard Space Flight Center.

TITAN CENTAUR LAUNCHES SOLAR SCIENCE MISSION

The Helios-A spacecraft was successfully launched from Cape Canaveral on Dec. 10, 1974, by a Titan Centaur launch vehicle. The spoolshaped spacecraft named for the sun god of ancient Greece is a solar probe built by West Germany as part of a joint venture with the United States. It will fly closer to the Sun than any previous spacecraft and will encounter temperatures hot enough to melt lead.

Three of the 10 experiments aboard the highly sophisticated German spacecraft are American. The experiments are designed to obtain new information on interplanetary space in the region close to the Sun. The instruments on Helios will measure the solar wind, magnetic fields, solar and galactic cosmic rays, electromagnetic waves, micrometeoroids, and the zodiacal light. Additionally, information concerning celestial mechanics, relativity and the Sun's atmosphere will be derived from analysis of spacecraft radio signals and tracking data.

The Helios mission was the first operational mission for the Titan Centaur launch vehicle. The only other flight of a Titan Centaur took place on Feb. 11, 1974, to test the launch vehicle's readiness to undertake a wide variety of missions, including the Viking mission to Mars. During the flight the Centaur main engines failed to ignite; however, sufficient data was received from the flight to show that integration of the two vehicles had been successfully accomplished.

The Titan Centaur proceeded through a normal operational mission consisting of the Titan boost phase and two burns of the Centaur stage. Following the second Centaur burn, a fourth stage with the Helios spacecraft was separated and injected the Helios spacecraft into a heliocentric orbit. This was the first flight of the spin-stabilized fourth stage on a Titan Centaur launch vehicle.

Following the successful insertion of Helios into solar orbit, the Centaur began an extended mission to carry out several experiments designed to test the ability to directly insert spacecraft into Earth synchronous orbits. Such missions require long coast periods, up to five hours, and restart of the main engines with a relatively small amount of propellants remaining in the tanks.

FIRST FRENCH/GERMAN COMMUNICATIONS SATELLITE LAUNCHED BY NASA

The first French/German communications satellite was successfully launched aboard a Delta rocket from the Kennedy Space Center on Dec. 18, 1974. The experimental satellite, called Symphonie, will test and demonstrate communications equipment for television, radio, telephone, telegraph, and data transmission. The satellite will be capable of transmitting between ground stations in portions of North and South America, Europe, Africa, and the Middle East.

Liquid fuel was used for Symphonie's apogee motor, which was fired by the Symphonie ground station at Oberpfaffenhofen, Germany, on Dec. 22. This was the first use of liquid fuel for the apogee motor of a spacecraft planned for synchronous orbit. The burn of about 20 minutes duration was completed successfully. The spacecraft was drifted eastward at about five degrees per day to reach its station above the South Atlantic west of the African continent and began initial operations on Jan. 2.

The Symphonie-A spacecraft was launched by a three-stage, thrust-augmented NASA Delta 2914 launch vehicle. The Delta placed the spacecraft in a nearly perfect transfer orbit. This was the 104th Delta launch and the 44th time that a non-NASA group has purchased a Delta vehicle and complete launch services from NASA.

NASA, SCIENCE FOUNDATION SIGN AGREEMENT ON ENERGY STUDIES

The National Science Foundation (NSF) has signed a memorandum of understanding with NASA for collaboration in research on terrestrial uses of solar energy. NSF is the lead Federal agency in solar energy research. A National Solar Energy Research Program, developed through interagency studies under NSF leadership, aims at achieving significant contributions to the United States energy supply by the 1980s.

The NSF-NASA agreement is one of a number through which NSF will collaborate with other Federal agencies having a present or prospective role in bringing solar energy systems into widespread use.

NASA, already working on wind energy systems in NSF-supported wind energy projects, is expected to have a part in the full range of solar energy research.

An Interagency Panel for Terrestrial Applications of Solar Energy, chaired by NSF, has been established to coordinate the National Solar Energy Program. In all, 21 Federal agencies, including NSF, are participating or will participate in the research, as well as industry, universities, and private research organizations.

The memorandum of understanding with NASA is directed to projects in fields in which NASA has special capabilities, within the broad range of solar energy technologies. For all the uses of solar energy under study, the basic technology is already available. A principal task of the research is to move toward practical systems and to bring costs down to a level competitive with conventional means of energy supply.

NASA TESTS LIGHTWEIGHT MATERIAL IN AIRCRAFT WINGS

Lighter, stronger, and longer-lasting aircraft through the use of composite reinforced structures is the objective of a joint NASA/USAF flight evaluation program.

Increased payload capability and resistance to structural fatigue are expected in tests of two C-130 aircraft which have center wing boxes reinforced with boron-epoxy composite. The wing box is 36 feet long and includes mounts for the inboard engines of the C-130. The composite reinforcement permits thinner gauge metal to be used, and the resulting 500-pound weight saving can be applied to increase aircraft payload or fuel. Because of their stiffness and strength, composite materials are expected to increase the life of the structure by reducing its susceptibility to fatigue damage.

The composite reinforcement consists of boron filaments embedded in an epoxy resin. It is supplied in tape form to the airframe manufacturer. Several tapes are laminated to the desired thickness and bonded with adhesive only to those portions of the basic metal structure where it will be of maximum benefit.

The first of the two C-130s were delivered to the Air Force on Oct. 23. Both will be assigned to the 314th Tactical Airlift Wing at Little Rock Air Force Base, AR.

Data obtained on the life of the composite materials and on their fatigue characteristics under flight conditions will help provide the confidence to proceed with their use in new aircraft design. Lockheed Aircraft Corp., the airplane manufacturer, will conduct periodic inspections of the test aircraft over a three-year period and report its findings to NASA and the Air Force.

LANGLEY REFINING PERSENT STOL CONCEPTS

The Langley Research Center is refining present concepts of its short-takeoff-and-landing (STOL) aircraft. Included are the Air Force Boeing YC-14 that employs upper-surface blowing where the jet exhaust is directed along the curvature of the top side of the wing, and the McDonnell Douglas YC-15 that uses externally blown flaps in which the exhaust from underwing-podded engines impinges directly on large slotted flaps to develop high life. Langley pioneered and has extensively tested both advanced medium STOL transport (AMST) prototypes.

Langley has wind-tunnel tested a full-scale Rockwell Aero Commander fitted with Pratt & Whitney JT15D engines in the upper–surface blowing configuration. Realistic hot–jet data on the static and dynamic loads and aerodynamics of such a system were obtained. Engine–out characteristics also were studied. The YC–14 will use differentially blown ailerons to provide roll control in the asymmetric thrust condition. The environment of the upper wing surface is a matter for concern, especially with nozzles that direct the jet exhaust down against the wing in order to achieve the desirable spanwise spreading of the flow.

Data from the AMST programs will be used in any future FAA certification of either aircraft or of powered–lift aircraft generally.

COUSTEAU AND NASA STUDY MARINE ENVIRONMENT

Captain Jacques Yves Cousteau's research vessel Calypso will undertake a variety of oceanographic and weather experiments for NASA in cooperation with the Texas A&M University as part of Captain Cousteau's latest study of the ecology of the oceans.

As part of a broad exploration of the marine environment, the Calypso researchers plan to measure the chemical content of seawater, temperature, depth factors, water colors, and kinds and quantities of pollutants present in various regions.

The Calypso left Galveston, TX, Oct. 15 to begin a nine-month voyage through the Gulf of Mexico, the Caribbean Sea and the eastern Pacific Ocean off Mexico and South America.

Weather and oceanography experiments sponsored by NASA and Texas A&M will be carried out with the aid of satellites and high-altitude aircraft such as the U–2 in flights over the Calypso. Companion equipment, designed to translate space-collected data quickly and efficiently into useable forms, is carried aboard the floating laboratory, including satellite communications equipment and an Applications Technology Satellite–3 (ATS–3) surface terminal which permits daily contact with Goddard Space Flight Center and Texas A&M. Four graduate students from the university will travel aboard the Calypso to assist with the NASA onboard experiments, under the supervision of their professors.

The sophisticated equipment used in the Calypso studies and the synchronized approach—in which appraisals of weather and water conditions collected by satellites and high-flying U–2s can be measured against similar data collected by traditional means at the sea surface—is seen by scientists as an important evolutionary step toward fast and accurate assessments of significant aspects of ocean ecology.

Monitoring of the cruise pattern of the Calypso by NASA satellites has been done on past expeditions. The research ship also has carried space agency equipment designed to assess weather and oceanographic conditions in various parts of the world's oceans. During the last Calypso expedition, a hazardous voyage that ended in 1973, Captain Cousteau called the satellite assistance the Calypso received "the most valuable tool we had to plan our trip."

SPACE AGE INVENTIONS—HANDTOOLS FROM NASA

Spinoffs from aerospace research at NASA have brought about improvements in such commonplace handtools as the screwdriver. A recently released NASA booklet, "Hand Tools," describes a variety of these useful developments.

For example, the conventional screwdriver tends to cause burrs at the edges of the screw slot. Why? Because the taper at the tip of the screwdriver puts the torque load on the top edges of the slot, tending to force the screwdriver out of the slot. By widening the tip of the screwdriver, the torque load is shifted away from the edges, preventing burrs.

Another handtool, a modification of a conventional papercutter, shears flat multiconductor cables and slits the insulation between the conductors. After positioning the flat conductor cable and squeezing the two lever arms together, the flat cable is cut at 90 degrees. By pulling one of the levers outward, the insulation is slit at the end, separating the individual conductors.

NASA GRAPHIC PROFILE CHANGE

Under the Federal Graphics Improvement Program of the National Endowment for the Arts, initiated by the President in May, 1972, and participated in by NASA since early last year, a panel of graphic design experts has recommended a number of steps to improve the agency's ability to communicate internally and externally.

In accepting the recommendations, after he and Dr. George M. Low, NASA Deputy Administrator, had reviewed the findings, Dr. James C. Fletcher, Administrator, said:

"We at NASA believe that design excellence is not a luxury, but rather a necessity. We believe that it is important to constantly upgrade the quality of our graphics in order to improve communications with the citizens of our country and to develop a closer relationship between graphic design and program operation so that design becomes a tool in achieving the program objectives of NASA."

The new system will embrace all means of communications with the public and within the agency from publications to stationery, from press releases to vehicle identification and signage, to a new agency logotype.

NASA

The central element of the new system is this logotype. In this, the letters "N–A–S–A" have been reduced to their simplest possible form. The strokes are all one width, the panel explained, giving a feeling of unity and technological precision. Elimination of cross-strokes in the A's results in two "nose-cone" shapes within the logotype, imparting a "vertical thrust" to the total unit.

The panel that worked out the system evaluated hundreds of samples of NASA graphic material from all Centers. Members included Marion Swannie, Design Program Manager, IBM; Alvin Eisenman, Chairman of the Graphics Department at Yale University; Paul Rand, nationally known graphics

designer; Howard Paine, National Geographic Magazine; and John Leslie, U.S. Department of Labor.

NASA has contracted with Danne & Blackburn, a New York City graphics concern, for a preliminary report and plan for implementation of the Graphics Improvement System. Its representatives will visit NASA Centers early in 1975 to discuss the program and work out details of a graphic manual for distribution throughout the agency.

FLETCHER LISTS 4 POINTS BACKING SCIENCE PROGRAMS

Discusses Space Plans and Achievements On Town Hall on the Air Forum

Four points in support of going ahead with the space science and planetary exploration programs projected in connection with the space effort were listed by Dr. James C. Fletcher, NASA Administrator, during remarks as guest speaker on the Town Hall on the Air forum in California Dec. 3.

He referred to them after giving a full discussion of the ongoing space program and that planned for the 1980s, dividing his remarks into these categories: Space Shuttle program, applications satellites, development of new scientific satellites, planetary exploration, and application of new space technology and skills to non–space activities on Earth.

"We have a very challenging program ahead," he said, "and it promises very rich returns. And we do not plan to change our level of spending any. We have come down a factor of about three from the peak in 1967, peak of the Apollo program.

"At this level we can do all the things that I described earlier. And I think we will continue to have strong support, although in some areas we may have some difficulty.

"I think the Shuttle is in a safe situation; the aeronautics program is safe; and the applications program is safe.

"If there is any place we are vulnerable, it would be in our space science and planetary exploration program, because that has long-range benefits, and in times of stress, economic stress, the focus always tends to be on solving our problems right now and saving money."

He added: "I think we will go ahead with these scientific programs, and, in support of this, I would like to make four principal points.

Points to Support Program

"Point No. 1: It is incorrect to say that the space science programs can be put off indefinitely. We now have the teams in being to do this kind of work. They are an important national resource, and an important resource for all of mankind. They must be given challenging work to do, or their unique skills and experience will be lost.

"Space exploration, to be productive, can't be a now–and–then activity. It must be a steady, even level of effort.

"Point No. 2: Space science does produce practical benefits. We can't always predict what they will be, but they are inevitable. The more we learn about the atmospheres of other planets, the better we will be able to understand the weather and climate on Earth, and the better we will be able to understand and protect our own atmosphere from the kinds of pollution that may destroy life on this planet, if we are not careful.

"Point No. 3: These scientific programs force the development of valuable new technology, such as the development of atomic power sources for the tiny Pioneer spacecraft that are exploring Jupiter, and Saturn is one example out of many.

"The automated Laboratories that will land on Mars in 1976 will advance the art and science of cybernetics and benefit us all in many ways.

"As a nation, we can make an important part of our living from the sale of high technology products and processes abroad.

"I, personally, don't know of a better way for the Federal Government to help American industry keep ahead of competition than investing in high technology. And I think that was the thrust of the President's remarks on the day we presented him with a crystal produced aboard Skylab—that that is the way that we can be competitive abroad.

Point No. 4 Valid

"Point No. 4: This may escape some of us, but nevertheless I think it a valid point.

"Our space science programs and our voyages to the planets are a special kind of investment. They are more than an investment in high technology or in potential practical benefits; they are more than an investment in a better America; they are a long-term investment in the future of the human race.

"We have the capability to begin acquiring the technology and the experience we need to move some of our people beyond planet Earth and establish the first colonies in either Earth orbit or solar orbit, or on the planets.

"No other human beings in the history of the world have had this capability. Our forefathers, down through the ages, could only dream of such ventures. We, now, have the capabilities and the clear challenge to start making these dreams come true.

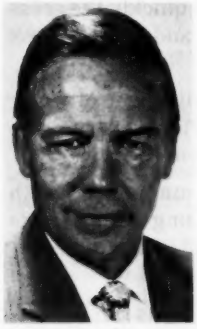
"The present state of the world with threatened overcrowding and diminished natural resources is giving us a push as well.

"Pioneer, Mariner and Viking are blazing a trail for us, and our aim is to keep these trailblazers on the job and to follow them in due time with people, extending man's habitat beyond the Earth and into the solar system."

SCHERER TO HEAD KSC

Capt. Lee R. Scherer, USN (Ret.), Director of Flight Research Center since October, 1971, has been named Director of the Kennedy Space Center, succeeding Dr. Kurt H. Debus, who retired Oct. 9.

Scherer will take up his new duties in mid-January, 1975. Until that time, Miles Ross will continue as Acting Director.



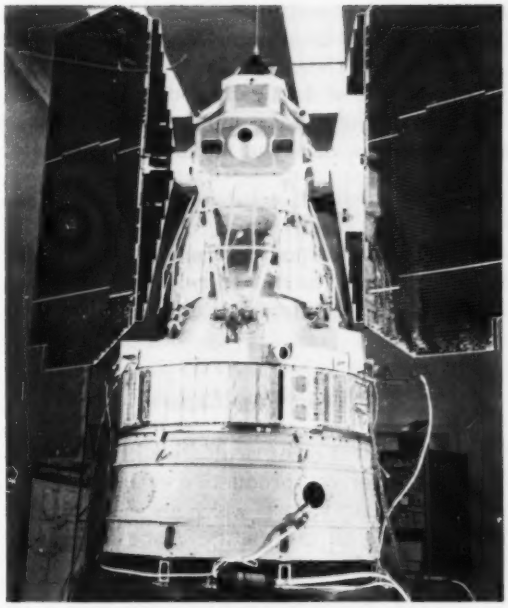
Lee R. Scherer

No successor to Scherer at FRC has been announced.

Prior to joining FRC, Scherer was Director of the Lunar Exploration Office for Project Apollo. Before that, he was Program Manager for the Lunar Orbiter, a position he assumed in 1962 while on temporary assignment from the U.S. Navy.

Scherer, a graduate of the U.S. Naval Academy, retired from the Navy with the rank of Captain in 1964, after 25 years of service. For his efforts in behalf of the space program, he has received NASA's Exceptional Service Award, Exceptional Scientific Achievement Medal, and Distinguished Service Medal.

Kennedy Space Center, conducting an active program in support of NASA's EEO program, placed minorities in about 30 percent of all positions filled during 1974. A large number of new employees were hired in professional/scientific/engineering or professional administrative categories.



ERTS spacecraft in flight configuration

ERTS-B TO BE LAUNCHED

A picture-taking satellite that NASA is preparing to launch from California about Jan. 19 is expected to provide new help in managing Earth's natural resources and in protecting its environment.

The second Earth Resources Technology Satellite—ERTS-B, to be designated ERTS-2 when in orbit—will team up with ERTS-1, in operation since July, 1972, to provide repetitive coverage of almost the entire globe.

"If I had to pick one spacecraft, on Space Age development to save the world," Dr. James C. Fletcher, NASA Administrator, said recently, "I would pick ERTS and the satellites which I believe will evolve from the program later in this decade."

DATA from ERTS-2 will be used by more than 100 research teams in Federal, state, and foreign governments, international organizations, universities, and private companies for a broad range of Earth studies in more than 40 states and more than 40 foreign countries.

In addition, NASA, in cooperation with Federal and state agencies, will conduct a number of experimental demonstrations designed to show the practical benefits in resource management of multi-spectral remote sensing from space. These include experinents in water management, agriculture, and land use planning.

One is a Large Area Crop Inventory Experiment (LACIE), a joint investigation with the U.S. De-

partment of Agriculture and the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). It is designed to test whether the use of data gathered by spacecraft and analyzed with the aid of computers can improve the timeliness and accuracy of major crop forecasts.

The experiment will combine crop acreage measurements obtained from ERTS data with meteorological information from NOAA satellites and from ground stations to relate weather conditions to yield assessment and ultimately to production forecasts.

Use in Crop Reports

The Department of Agriculture will study the experimentally derived production estimates for possible use in its crop reports which are made public as a routine service to the domestic and international agricultural community.

At the outset, LACIE will concentrate on wheat grown in North America. If this activity proves successful and useful, it will be extended in the second year to other regions and ultimately to other crops.

Speaking before the UN World Food Conference in Rome last fall, Secretary of State Henry A. Kissinger called the experiment "a promising and potentially vital contribution to rational planning of global production."

Besides the Department of Agriculture and NOAA, user agencies working with NASA in the ERTS program include the Department of the Interior, the Environmental Protection Agency, the U.S. Army Corps of Engineers, and a number of regional, state, and local organizations.

The primary objective of the ERTS missions is the acquisition of multi-spectral repetitive data of the surface of the Earth in the form of imagery or in digital format on magnetic tape. Another objective is the development of a relay system to gather data from remote, widely distributed ground sensor platforms.

ERTS-1 data is providing new insight into man's continuing efforts to better manage the Earth's limited resources, as well as aiding in the assessment and understanding of environmental changes. Areas in which this data is applicable include: agriculture, range resources, environment, forestry, geology, land use, marine resources, meteorology, and water resources.

ERTS-1 Contributions

In its 29 months in orbit, ERTS-1, making a complete cycle over the entire Earth every 18 days, has returned more than 100,000 images. Analysis of these images by the world's scientific and technical community has produced numerous beneficial results, including the following:

—Accurate estimates of the acreage of and determination of the growth status of wheat, barley, corn, and rice at various times during the growing year.

—Evidence of how controlled grazing in the desert areas of the Sahelian region in Africa can lead to the reclamation of desert land for productive use.

—Accurate estimates of timber volume and of the extent and volume of timber taken through clear-cutting and other timber industry techniques for ecological and management purposes.

—Up-to-date maps prepared in a matter of days compared to months and years previously.

—Estimates of actual areas covered by water that are replacing previously used rough estimates.

—Before and after views of river flood areas which make it possible to ascertain quickly the areas covered by water for flood relief and flood control purposes.

—Accurate prediction and management of water runoff from snowmelt which provides a large portion of usable water in the Western U.S.

—Identification of previously unknown Earth structural features, particularly long linear faults and fractures important for the detection of minerals and potential earthquake zones.

—Classification of strip-mined areas for estimation of mined acreage and reclaimed regions, monitoring of changes in protected wetlands areas due to construction and dredging and filling operations, and the detection of large-scale dumpings and outfalls in bodies of water.

NASA tracked the Soviet Soyuz 16 spacecraft after its launch on Dec. 2 and shortly afterward began a 15-hour joint tracking exercise with the Soviet Union. After the mission, information gathered by nine U.S. tracking stations was compared to data received by Soviet stations during the same period. The exercise was a forerunner of tracking operations and data comparison which will be required during the Apollo-Soyuz Test Project mission next July.

FROM THE PRESIDENT—Early in December, Dr. George M. Low, Deputy Administrator of NASA, received the 1974 Rockefeller Public Service Award for Administration at a luncheon ceremony in Washington. An outstanding honor for veteran civil servants, it was presented to him, as shown here, by President Ford, who, along with John D. Rockefeller, III, by whom the award is financed, took part in the program.

KILGORE TRANSFER ANNOUNCED

Edwin C. Kilgore, Deputy Associate Administrator for Center Operations at Headquarters, has been named Director for Management Operations at Langley Research Center, effective March 1, 1975.

His new position will encompass the functions of Raymond G. Romatowski, Director for Administration, who will be transferred to Headquarters on that date as Assistant Administrator for Personnel Programs, and of T. Melvin Butler, Director for Center Development and External Affairs, who retired in late December.

In announcing the key management changes, Edgar M. Cortright, Director of LaRC, said: "All three of the individuals concerned have outstanding records of achievement. While we hate to lose Mel Butler to retirement, and Ray Romatowski to Washington, we are extremely fortunate to have a man like Ed Kilgore return to Langley to pick up the load."

Kilgore was transferred to Headquarters from Langley in 1970 and served as Acting Associate Administrator for Aeronautics and Space Technology and as Deputy Associate Administrator (Management). At LaRC, he had served in several increasingly responsible positions and, from 1968–70, was Deputy Chief of the Office of Engineering and Technical Services.

INTERNATIONAL SPACE DINNER

A dinner with a strictly international flavor, even to the items on its menu, and with a strong overtone looking toward Spacelab and the Shuttle, was held at Alexandria, VA, on Dec. 5.

Host for the occasion was Henry J. Kuss, Jr., President of VFW-Fokker of America, a subsidiary of the multi-national European company of that name. He was accompanied by his wife.

Guests of honor were all from Europe. They were Prof. Gerhard Eggers, Senior Executive of VFW-Fokker and a member of its Board of Management, who came from its headquarters in Dusseldorf; Hans Hoffmann, VFW-Fokker/ERNO's Managing Director of Technical Operations, from Bremen; and Heinz Stoewar, Acting Spacelab Project Manager of the European Space Research Organization (ESRO), from the Netherlands.

ESRO awarded the prime contract to VFW-Fokker to build the Spacelab for the Shuttle Program. It is to be financed by 10 foreign nations. ERNO is a wholly owned subsidiary of VFW-Fokker.

TALKING INTERNATIONAL SPACE—Hans Hoffman, Managing Director of Technical Operations for VFW-Fokker/ERNO, the multi-national company now building the Spacelab, discusses his work with Dr. Ruth I. Mathews, Public Relations Consultant for VFW-Fokker of America, at the recent international dinner at which he and two other European officials were entertained.

NASA was represented at the dinner by John F. Yardley, Associate Administrator for Manned Space Flight; Dr. Myron S. Malkin, Director of the Space Shuttle Program; and Douglas Lord, Director of the Spacelab Program. They were accompanied by their wives.

Other guests included Dr. Klaus Wiendiezk, Counselor for Scientific Affairs at the Embassy of the Federal Republic of Germany, and Dr. Leo S. Packer, Director of the Office of Technology Policy and Space Affairs at the State Department, and their wives.

Also present from VFW-Fokker of America were Dr. Peter A. Gerardi, Vice President, and Mrs. Gerardi, and Dr. Ruth I. Matthews, Public Relations Consultant.

SATELLITE BEGINS SECOND LAP OF JOURNEY TO SATURN

Opens New Era in Space Exploration, Heading Toward 1979 Closeup of Ringed Planet

Already more than half a billion miles from Earth this month, a tiny American space robot has begun the second lap of an incredible journey that clearly marks the opening of a new era in space exploration.

Newly-named Pioneer Saturn, formerly Pioneer 11, is spinning through the icy emptiness of space on a 1.5-billion-mile journey that will take it to Saturn for man's first closeup look at the ringed planet in 1979.

Only weeks before, the robot spacecraft—pelted by a cataclysm of protons and electrons more deadly than a dozen hydrogen bombs—had skimmed past giant Jupiter and returned stunning photographs of polar regions never before seen.

Once primarily a backup for its sister craft, Pioneer 10—now headed beyond the solar system—Pioneer 11 not only verified many of the astonishing year-old discoveries of Pioneer 10, but made some of its own.

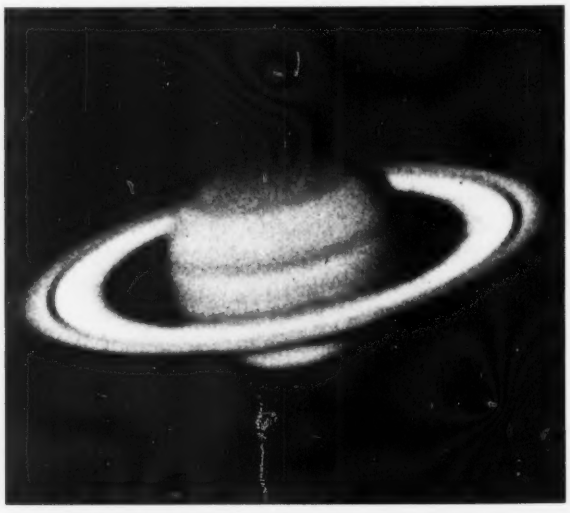
The bonanza of information included:

- Sensational pictures of Jupiter's north polar region marked by spiralling, almost concentric cloud bands, views never before seen from Earth.
- New studies of the planet's temperature, radiation levels and magnetic fields.
- The first measurement of Amalthea, smallest and innermost of Jupiter's 13 known moons.

Robert S. Kraemer
Director,
Planetary Programs

The Pioneer 11 data confirmed that Jupiter is primarily a whirling ball of hydrogen, and that it radiates more heat than it absorbs from the Sun. Its atmosphere, capped by a brightly banded cloud layer, is driven convectively. It is surrounded by a complex magnetic field and very powerful belts of trapped charged particles, both of which are vastly different in their inner and outer reaches. The inner magnetic field is tilted with respect to Jupiter's spin axis, and displaced from the center of the planet, like a spinning plate teetering and wobbling on the top of a juggler's stick.

Past Jupiter . . . . .



. . . . And on to Saturn

Slingshot Technique Sound

The spacecraft's rich harvest of information demonstrated the basic soundness of NASA's gravity-powered slingshot technique used for the first time a year ago to bend the trajectory of Mariner 10 towards Mercury after flying past Venus. This two-for-one concept provides a wealth of data at a minimum expenditure of time and cost.

In the case of Pioneer, the massive gravity of Jupiter was used to boomerang the spacecraft across the solar system on a loping 1.5-billion-mile trajectory toward Saturn. The 570-pound spacecraft won't get to Saturn for another five years, but scientists hope the spacecraft will be working so well when it gets there that it will be flown between the rings and the planet and go on to an encounter with Titan, largest (3,000 miles wide) of Saturn's 10 moons and a body which some scientists believe could support some form of life. Measurements from Earth have detected an atmosphere containing both methane and oxygen.

When Pioneer gets to Saturn, its radio signal will take 90 minutes (compared to 41 minutes for Jupiter) to reach the huge antennas in Australia and the California desert that will be straining their electronic ears to hear it.

F. D. Kochendorfer
Pioneer Program
Manager

Space scientists believe the strain will be worth it. Saturn, the second largest planet in the solar system, has never been explored before. Made mostly of hydrogen, it is the lightest of the planets—light enough to float in water.

Saturn is circled by three majestic rings—the only planet like it in the solar system. The rings orbit Saturn out to a distance of 170,000 miles, with the innermost ring only 9,000 miles from the planet's surface. Radar studies suggest that the rings are composed of icy rocks, ranging from pebbles to huge boulders.

One trajectory would take Pioneer within 6,000 miles of the planet's surface in September, 1979, and then to the planet's moon, Titan, 700,000 miles away, flying by—and hopefully taking pictures of—that natural satellite from a distance of 12,000 miles.

Mariner 10 Approaching Mercury

At the opposite end of the solar system, Mariner 10, the first to use the gravity-assist technique, was approaching tiny Mercury for the third time. Early in 1974, Mariner had flown by the cloudtops of Venus, taking man's first closeup pictures, and then to within 450 miles of Mercury. Next, it swung around the Sun and passed by Mercury a second time last Sept. 21. Mariner 10 is scheduled to make its third pass on March 16.

Prior to the flight of Mariner, Mercury was a hazy image in the lens of even the most powerful ground-based telescopes. Now scientists are inundated in a sea of new findings.

Albert G. Opp
Pioneer Program
Scientist

Television pictures from the spacecraft improved the visibility of the planet's surface by a factor of 5,000, revealing a rugged topography that scientists believe may have remained unchanged since the infancy of the solar system.

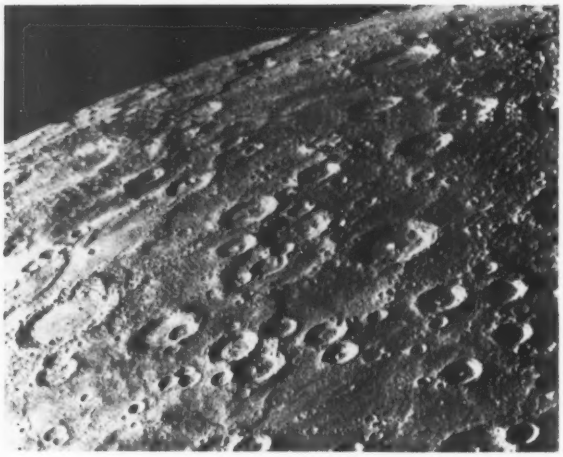
The surface resembles the pockmarked crust of the Moon; yet Mercury probably has an iron core, like the Earth. Two of the most unexpected findings were the discovery of a weak magnetic field and a thin atmosphere composed in part of helium.

In addition to its scientific and engineering achievements, the flight of Mariner 10 has proved a "valuable object lesson on how NASA, aerospace industry contractors and participating scientists can cooperate effectively to cut the costs of space exploration," according to Dr. George M. Low, NASA's Deputy Administrator (NASA ACTIVITIES, Dec. 15, 1974).

"Mariner 10 did not exceed its planned design costs," he said, "and demonstrated that it can be done. This is a lesson we need to take to heart in the years just ahead."

As a result of the successful close encounters in 1973 and 1974, prospects for the success of future planetary missions have risen substantially. More has been learned about Jupiter in the last year than in all the time that has gone before. Mercury has been seen close up for the first time, and cloud-shrouded Venus has begun to yield some of its secrets to the persistent probing and peering of robot visitors from Earth.

About July 4, 1976, a Viking spacecraft will land on Mars; in 1977, a Mariner will be launched toward Jupiter and Saturn; in 1978, a Pioneer will be dispatched to Venus and, in 1979, Pioneer 11 will visit Saturn for the first time.



Mercury: From 49,000 Miles

Venus: From 450,000 Miles

WHITCOMB REWARDED AGAIN

Dr. Richard T. Whitcomb of Langley Research Center, already much saluted for his invention of the supercritical wing, was presented another award at a ceremony in Washington on Dec. 13, this time the Wright Brothers Memorial Trophy.

Among recognitions received earlier by the Head of the Eight-Foot Tunnels Branch of the High-Speed Aircraft Division at LeRC were a $25,000 cash award from NASA and the National Medal of Science, the Federal Government's highest award for distinguished achievement in that field.

REWARD FOR SUPERCRITICAL WING—Dr. Richard T. Whitcomb receives from John B. Montgomery (right), President of the National Aeronautical Association, the 1974 Wright Brothers Memorial Trophy presented him for inventing the supercritical wing.

The Wright Brothers Memorial Trophy, given annually for "significant public service of enduring value to aviation in the United States," is an award of the National Aeronautical Association and is made at the Aero Club of Washington's Annual Wright Brothers Memorial Banquet, usually held on or about Dec. 17, anniversary of the first successful flight of an airplane.

As the recipient of the 1974 Wright Trophy, Dr. Whitcomb's name is added to a distinguished list of NACA and NASA personnel who received the prestigious award in past years.

Dr. Hugh L. Dryden received the Wright Trophy in 1955 as Director of NACA. John F. Victory was Executive Secretary of NACA when he was the recipient in 1958. John Stack of Langley Research Center was the 1962 recipient.

Jerome Lederer, the 1965 winner, received the award primarily for his many accomplishments in the field of aeronautical safety, especially while working at the Flight Safety Foundation. He had served for many years on NACA and NASA technical committees, entering the employ of NASA in 1967 as Director of the Office of Manned Space Flight Safety.

Many members of NACA received the Wright Trophy. The list includes: Dr. William Durant, in 1948 the first recipient; Charles A. Lindbergh, in 1949; Dr. Jerome Hunsaker, in 1951; Gen. James Doolittle, in 1952; Dr. Edward Warner, in 1956; William P. McCracken, Jr., in 1959; Frederick Crawford, in 1960; and Harry Guggenheim, in 1964.

SWING-WING SHOWS PROMISE

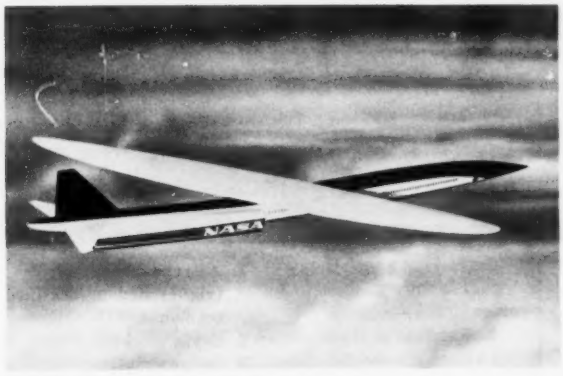
Results from new studies and tests indicate that NASA's swing-wing aircraft configuration holds promise of becoming a practical approach to an advanced commercial jet transport. It may also provide solutions to a number of transport aircraft problems.

The wing and fuselage of the new concept relate to each other like the two halves of a pair of scissors. The straight wing is mounted above the body and can be turned to various oblique angles for best performance at different flight speeds. For slower flight, the wing would be fixed at right angles to the fuselage, allowing landings and takeoffs with a minimum of power and noise.

The merits of the concept have been established through several years of intensive analyses and wind tunnel investigations at Ames Research Center, supported by a $300,000 NASA-funded study by the Boeing Commercial Airplane Co. at Renton, WA. For the first time the Boeing study has converted the swing-wing concept into an integrated design for a jet transport.

The concept was developed by Dr. Robert T. Jones of ARC. He is also responsible for the introduction in 1945 of swept-back wings, now a common feature of transport aircraft.

Because the new design can operate with maximum efficiency over a wide speed range, and therefore has such great operating flexibility, engineers point out that it could provide shorter flight times with little increase in overall fuel consumption. Some combinations of speeds and schedules could produce significant fuel savings by using the substantial fuel economy of straight-wing flight in such situations as holding patterns at airports.



SWING-WING AIRCRAFT—This scissor-like swing-wing aircraft configuration from NASA may offer a practical approach to an advanced commercial jet transport.

INTERCHANGE EXECUTIVES—Susan Norman (left) and Robert Button have been announced as NASA's choice to serve under the President's Executive Interchange Program.

INTERCHANGE EXECUTIVES CHOSEN

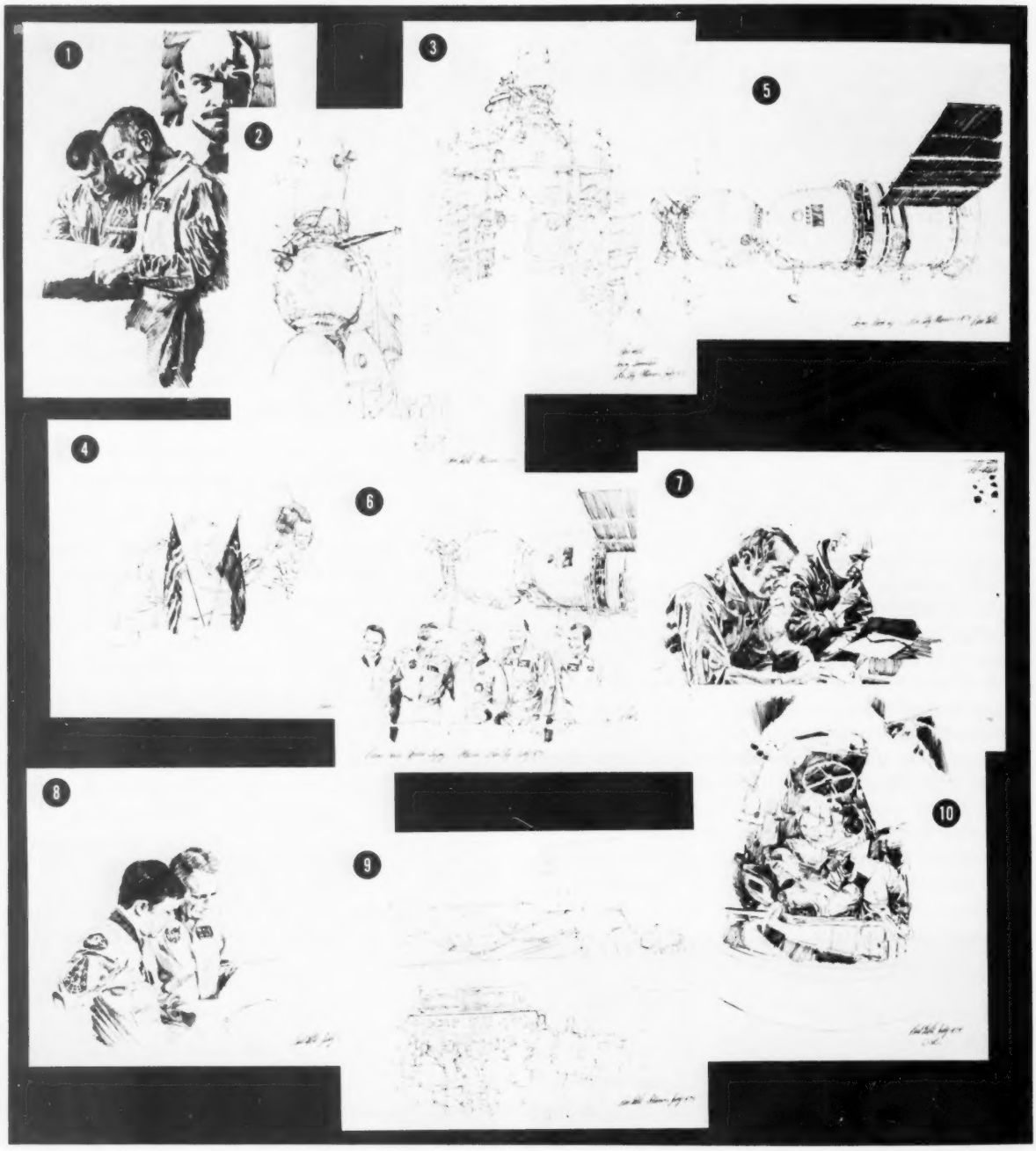
NASA has announced its choice of two individuals to serve under the President's Executive Interchange Program for 1974-75. They are Susan Norman, an Ames Research Center engineer in aeronautical systems, and Robert Button, Manager of Public Relations for Systems Group of TRW, Inc.

Under the program, established in 1969, highly talented executives are provided with an opportunity to gain experience by crossing sector lines to work temporarily in government or business during the important middle years of their careers. The term of service is usually one year.

Ms. Norman, who has been assigned to Sikorsky Aircraft Division of United Aircraft Corp., Stratford, CN, will serve on the staff of the Vice-President for Planning and will be involved in an overview of all planning operations, with particular emphasis on management information systems.

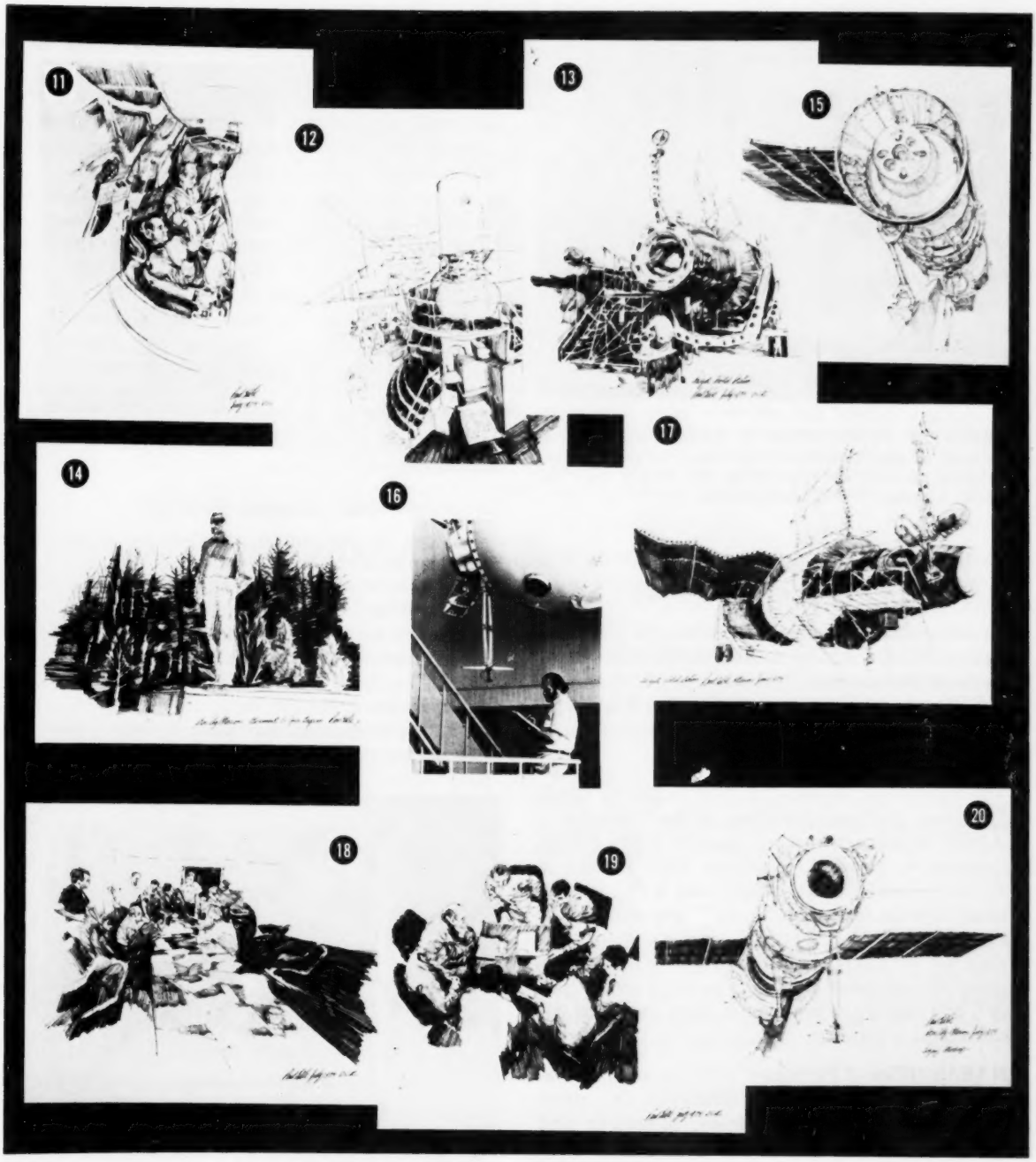
Button will work in NASA public relations as a Special Assistant to the Assistant Administrator for Public Affairs and as a Public Affairs Officer with duty station in New York City.

NASA has had a total of 10 Presidential Interchange Executives. Besides Ms. Norman and Button, they include Robert Craven, assigned from NASA Headquarters to Cummings Engineering Co. in 1970–71; James Wakefield, from LTV Electrosystems, Inc., to NASA Headquarters, in 1971–73; Percy Baynes, from GSFC to North American Rockwell in 1972–73; Alfred Christianson, from General Electric to NASA Headquarters in 1972—74; Michael Card, from LaRC to TRW Systems in 1972–73; Dean Klevin, from Recognition Equipment, Inc., to NASA Headquarters in 1973–74; and Junius Hayes, from the National Association of Black Manufacturers to NASA Headquarters in 1973–74.



These drawings by Artist Paul Calle of Stamford, CN, who was invited by NASA to document astronaut-cosmonaut crew training for the Apollo Soyuz Test Project, were done in Star City, USSR. A freelance artist since 1950, he covered activities in the Mercury, Gemini and Apollo programs, as well as other space activities.

1. Astronaut Slayton (right) and unidentified cosmonaut
2. Soyuz mockup
3. Soyuz simulator
4. Astronaut Stafford
5. Soyuz mockup



6. Astronauts and cosmonauts—prime Apollo-Soyuz crews
7. Astronauts Brand and Stafford
8. Astronauts during Apollo-Soyuz training exercise
9. U.S. and Soviet technicians work at their consoles—USSR spacecraft in background
10. Astronauts inside Soyuz mockup
11. Astronauts and cosmonauts inside Soyuz simulator
12. Flight simulator training facility
13. Salyut orbital station
14. Monument to Yuri Gagarin
15. Soyuz mockup
16. Artist Paul Calle making on-the-spot drawing of the Apollo-Soyuz crew training exercise
17. Salyut orbital station
18. Astronauts, cosmonauts and technicians
19. Astronauts and cosmonauts discuss flight plan
20. Soyuz mockup

EMPLOYEE AWARD—Clyde M. Webber (left), National President of the American Federation of Government Employees, accepts an Apollo Flag Kit Plaque from Dr. James C. Fletcher, NASA Administrator.

EMPLOYEES GIVEN AWARD

In recognition of their contributions to the space program, NASA employees who are members of the American Federation of Government Employees (AFGE) were presented an Apollo Flag Kit Plaque by Dr. James C. Fletcher, NASA Administrator, on Dec. 9.

The award was accepted in their behalf by Clyde M. Webber, National President of the Federation.

AFGE represents approximately 9,000 NASA employees in 11 local bargaining units located at JSC, KSC, LaRC, LeRC, MSFC and WFC. It is affiliated with the Industrial Union Department of the AFL–CIO; is the largest union of federal employees recognized by Executive Order 11491, as amended, "Labor-Management Relations in the Federal Service"; and currently represents more than 600,000 government workers.

NASA's Office of Personnel consults with the national office of the AFGE in Washington, DC, about agency-wide personnel policies, practices and working conditions of unit employees. The NASA employees represented by AFGE have made significant contributions to the aeronautics and space program for many years, officials point out, and are engaged in all major work activities of the agency, participating in research, engineering, programs and project management, technical support, clerical and administrative support, and other related functions.

INTERPRETING SKYLAB DATA

Dr. Elnar Tandberg-Hanssen, previously with the High Altitude Observatory at Boulder, CO, has joined the Marshall Space Flight Center and will analyze data from Skylab's SO56 X-ray Telescope experiment for studying the Sun in X-ray wavelengths during active and quiet periods.

His research concerns the identification of coronal transient phenomena caused by the passage of plasma clouds through the outer corona of the Sun.

Born at Bergen, Norway, in 1921, Dr. Tandberg-Hanssen served at the Institute of Astrophysics, Oslo, Norway; the Institut d'Astrophysique, Paris, France; the Cavendish Laboratory, Cambridge, England; and then came to the U.S. in 1965 to serve on the Senior Research Staff of the High Altitude Observatory and in the Department of Physics and Astrophysics at the University of Colorado.

RIF COMING AT MSFC

Notices to personnel affected by a planned reduction-in-force at the Marshall Space Flight Center will be issued about the middle of January, 1975, with the effective data late in February.

The exact number to be affected is not yet known. The Center must reduce to a personnel level of 4,145. The level at the first of December was slightly under 4,300, but figures were not yet available on the number of employees retiring at the end of December.

SIMULATED SPACE TEST—In another "first" for the nation's space program, an all-female crew of scientific experimenters during December conducted a five-day exercise in materials science at MSFC that may lead to selection of experiments to fly on Space Shuttle/Spacelab Earth-orbital missions in the 1980s. Included were Dr. Mary H. Johnston (seated, left), Ann F. Whitaker and Carolyn S. Griner (standing, l to r), and the crew chief, Doris Chandler.

EXCESS OF SOLAR HEAT—Engineers and technicians working in the Marshall Space Flight Center's solar heated and cooled test residence can work in shirt-sleeve comfort, for solar energy collectors mounted on the roof of the building are providing much more heat than needed to maintain comfortable working temperatures. Left to right before a photograph of the demonstration house are Cary Reily, test engineer, and Dr. Randy Humphries and Marvin Hamilton, engineering analysts.

RESEARCH TERM COMPLETED

Dr. Thomas Rygg, a research associate at the Marshall Space Flight Center, has completed a two-year research project on the atomic analysis of heavy particles of cosmic and gamma rays just above the atmosphere.

In this research, a helium-filled balloon carried an instrument package to an altitude of 130,000 feet. Once at that height, the balloon, with instrument package still attached, drifted with the winds until the flight was terminated by radio command. The instrument data was sent back electronically and the signals recorded.

CORRECTION

In the Nov. 15 issue of NASA ACTIVITIES, p. 20, it was announced that Rhoda S. Bernstein of the Goddard Space Flight Center was among those who received the Exceptional Scientific Achievement Medal at the Annual Award Ceremony at Headquarters. The name should have been Horstein.

The phenomenal glitter of Io, one of Jupiter's moons and one of the brightest small objects in the sky, may be due to a surface rich in salt, according to a team of scientists at the Jet Propulsion Laboratory.

Io appears to have developed an extensive crystalline layer of sodium, much like some of the salt flats and dry lakes in the American West, Dr. Fraser P. Fanale, team leader, says.

"Io's situation is somewhat analogous to that of an Earth whose oceans have evaporated," he explains, "except that the salts are not predominately sodium chloride (table salt), but sulfates which dominate in the so-called 'bitter' lakes of the West. Examples are Verde Valley Lake in Arizona and Soda and Searles Lakes in California."

Robert C. Hock, KSC's Director of Executive Staff, retired from Federal service on Dec. 31. From June, 1971 to July, 1973, he was Manager of the Apollo–Skylab Program at KSC.

NASA has selected Singer Simulation Products Div., Houston, for negotiation leading to award of a contract for an Orbiter Aeroflight Simulator for use as a crew trainer for the Space Shuttle Orbiter Vehicle to support the Shuttle Program Office.

RADIO-TELEVISION
(Released Nationally)

TELEVISION—A two-story color film release in the *Aeronautics and Space Report* monthly televisions series, "Pioneer to Saturn" and "Space Shuttle."

RADIO—Four weekly *Space Story* programs have been released: "Apollo-Soyuz," (JSC/Stafford, Shatalov); "G.A.S.P.," (LeRC/Lezberg); "Pioneer Results," (ARC/Hall); and "Solar Cell Applications," (LeRC/Forestieri). One monthly *NASA Special Report*, "1974 in Review," (Hqs/Dr. James C. Fletcher).

LOOKING BACK ON 1974

The following excerpts are taken from the Headquarters roundup of the NASA highlights of last year (Release No. 74–330):

MANNED SPACE FLIGHT

Astronauts Carr, Gibson and Pogue, the first men to begin a new year in space, were awakened at 4:06 a.m. EDT on Jan. 1, 1974, as their orbital space station was over Hawaii on the 45th day of the Skylab 4 mission.

On Feb. 8, 39 days later, the astronauts splashed down into the Pacific Ocean off the coast of California, successfully completing the longest space mission ever attempted by man—in 84 days, 1 hour, 16 minutes.

Skylab accomplished more than was originally planned, both in manned hours in space and experiments data collected. It demonstrated that a properly designed station in space is feasible for men to live in and work in to increase knowledge of scientific phenomena and advanced technology.

The three Skylab crews spent 740 hours observing the Sun with telescopes and brought home more than 175,000 solar pictures. These are the first recordings of solar activity above Earth's obscuring atmospheric conditions. These data could revolutionize long standing theories of solar physics and may lead to utilization of the Sun's vast energy for practical use on Earth.

The 46,000 photographs and 40 miles of electronic data tape obtained by Skylab's Earth Resources instruments and cameras are already in use daily by government and industry for studies ranging from agriculture to zoology.

Data obtained by the third Skylab crew on Comet Kohoutek, coordinated with worldwide observations from Earth, provided the greatest advance in cometary research since the studies of the British astronomer, Edmund Halley, in the late 17th and 18th centuries.

To date, Skylab biomedical findings indicated that man adapts well and functions effectively in space for a period of almost three months, provided he has a proper diet and adequately programmed exercise, sleep, work and recreation periods.

Apollo Soyuz Test Project (ASTP)—the joint United States-Russian project to test the design of an international compatible docking system in space using an Apollo and a Soyuz spacecraft continues on schedule for a July 15, 1975, launch.

In 1974, the Apollo flight hardware fabrication and modification were completed and delivered to the Kennedy Space Center, FL, where space vehicle buildup, final checkout systems testing and launch preparations have started.

Last summer the U.S. prime and backup crews spent three weeks in the Soviet space center, Star City, near Moscow, training in simulators, mockups and conducting communications tests. In turn, the Russian cosmonauts spent three weeks in similar training at the Johnson Space Center, Houston, during September.

In 1974, great strides were made in the development of the future reusable Space Transportation System. The system, consisting of a Space Shuttle, Spacelab and Space Tug, is being developed as an economical and effective way of going into space in the 1980s and beyond.

At the Kennedy Space Center, FL, ground was broken in April for the Space Shuttle landing runway. The first horizontal flight tests of the Shuttle Orbiter, launched from a 747 aircraft, are to be made from the NASA Flight Center, CA, in 1977. The Center also will be the landing site for the first few Shuttle orbital test flights planned for 1979.

The European Space Research Organization (ESRO) will develop and manufacture Spacelab, the versatile new laboratory to be carried in the Space Shuttle cargo bay.

Aerial view showing construction progress on the Space Shuttle Landing Facility, with the Vehicle Assembly Building in the forefront.

Spacelab will accommodate up to four persons for as long as 30 days in Earth orbit. It is designed for conducting research investigations in Earth resources, solar physics, astronomy, engineering technology and life sciences.

A tentative agreement was reached with the Department of Defense for the Air Force to develop an early version of a Space Tug, an unmanned reusable stage that will fit in the Shuttle cargo bay for placing and retrieving payloads in orbit beyond the capability of the Shuttle.

SPACE SCIENCE

The United States continued its systematic exploration of the solar system in 1974, carrying out missions to three different planets—Venus, Mercury and Jupiter.

Pioneer 11, following up on the successful encounter of its predecessor, Pioneer 10, swept past Jupiter on Dec. 3, at a distance of 43,000 kilometers (27,000 miles), taking photographs and making measurements.

The encounter was three times closer than Pioneer 10 and culminated a two-year, billion-kilometer (600-million-mile) journey from Earth. The spacecraft flashed past the giant planet at a record speed of more than 160,000 km (100,000 miles) an hour, 55 times faster than a speeding bullet.

The Pioneer 11 data will add to the knowledge obtained by Pioneer 10, which painted a new picture of the solar system's largest planet.

Sifting through Pioneer 10 data, investigators concluded that Jupiter is a whirling ball of liquid hydrogen, without any detectable surface.

They also suggested that the Great Red Spot—a mystery since Galilieo first turned his telescope on it—is a gigantic hurricane which has been raging along a 40-km (25,000 mile) front for at least 400 years.

The data also provided new information on Jupiter's weather pattern, atmosphere and immense radiation belts.

Pioneer 10 is now on a five-year extended mission—to reach the orbit of Saturn in 1976, and the orbit of Uranus—the limit of spacecraft communications with Earth—in 1979. The spacecraft will then continue its journey into the far reaches of space, eventually becoming the first man-made object to escape the solar system, in 1986.

Pioneer 11 is headed for Saturn and will reach that planet in 1979, perhaps returning man's first closeup view of Saturn's mysterious rings.

Meanwhile, Mariner 10, the spacecraft that refused to quit, was headed for a third encounter with Mercury after twice looping around the Sun and flying by the planet in March and September, 1974. The spacecraft provided man with his first closeup look at this tiny planet, closest to the Sun. Along the way, Mariner 10 made striking photographs and returned important data on Venus, providing new clues to the origin and evolution of that cloud-shrouded planet.

Near year's end, on Dec. 10, scientists launched the first of two probes designed to fly closer to the Sun than any previous spacecraft. At times, Helios-A's subsystems will encounter temperatures hot enough to melt lead, 300 degrees C (700 degrees F). Flying within 45 million km (28 million miles), the German-American probe is designed to obtain new information on interplanetary space in the region close to the Sun.

The Helios launch marked the first flight of the Titan Centaur rocket since its unsuccessful maiden flight in February, when the Centaur main engines failed to ignite and the Centaur had to be destroyed by the range safety officer. The Titan Centaur has been assembled primarily for the Viking expedition to Mars next August.

Preparations continued toward the landing of an automated laboratory on the Red Planet, believed most likely to harbor life. In addition, NASA continued working toward a 1978 launch of a Mariner spacecraft to Jupiter and Saturn, and the launch of a Pioneer to Venus in 1978.

A variety of scientific satellites was launched by NASA in 1974, including an ever-increasing number for other nations on a reimbursable basis, especially Germany, France and Italy.

SPACE APPLICATIONS

At 9 a.m. EDT on July 2, the first educational course ever taught via space satellite television began with the transmission in color video of a college-credit lesson on the teaching of remedial reading from the University of Kentucky through NASA's new Applications Technology Satellite–6 (ATS–6) to 300 elementary school teachers in eight Appalachian states.

Soon ATS–6, the most powerful and versatile communications satellite ever developed, also was transmitting educational programs and health services to small, low-cost TV receivers in scores of isolated communities in the Rocky Mountains and Alaska, and to Veterans Administration hospitals in six Eastern states in a year-long experiment coor-

dinated by the U.S. Department of Health, Education and Welfare.

The satellite was launched May 30 from Cape Canaveral aboard an Air Force Titan III–C rocket and unfurled its big nine-meter (30-foot) antenna in geosynchronous orbit 35,680 km (22,300 miles) above the equator at a point due south of Kansas City, within communications range of all the Western Hemisphere.

Next summer it will be moved eastward to a point over Lake Victoria, East Africa, for a year's use by the government of India to transmit instructional programs to school children and adults in 5,000 isolated villages and cities throughout the vast Indian subcontinent.

Some 20 other experiments being conducted with ATS–6 include position-locating and communications demonstrations with commercial ships and aircraft on the busy North Atlantic traffic lanes.

As ATS–6 thus pushed back the frontiers of space communications, NASA on Nov. 21 launched a sixth Intelsat IV commercial communications satellite for the Communications Satellite Corp. (COMSAT). It will help handle increasing international telephone, television and data transmissions over the Pacific.

In another pioneering use of geosynchronous orbit—where a satellite travels at the same speed as the Earth's rotation, thus appearing to always remain over the same spot—NASA on May 17 launched the first Synchronous Meteorological Satellite (SMS–1).

From its perch above South America, SMS–1 can keep continuous watch on fast-changing storms, such as hurricanes and tornado-producing weather systems, sending back high-resolution pictures every 30 minutes.

Early in 1975, NASA will launch a second SMS, to be stationed farther west. The two will make up an operational weather satellite system of the National Oceanic and Atmospheric Administration (NOAA) that will maintain day-and-night surveillance over the U.S. and adjacent ocean areas.

Meantime, on Nov. 13, NASA launched the fourth in a series of ITOS/NOAA operational weather satellites that circle Earth from pole to pole, viewing each local area every 12 hours. Its Delta launch rocket also carried a small communications relay satellite, AMSAT–OSCAR–7, for use by amateur radio operators.

As 1974 ended, the first Earth Resources Technology Satellite (ESRO)—designed for one year's life—was completing its 29th month of highly productive operation and its 12,750th picture-taking circuit of the globe.

ERTS–1, orbiting 14 times a day, scans a swatch 185 km (115 miles) wide in four bands of the spectrum to produce images that reveal much about Earth's natural resources that can be used to help manage them more wisely.

From a 912-km (567-mile), near-polar, Sun-synchronous orbit, the satellite passed over almost the entire globe every 18 days and can view each cloud-free area at the same local time and thus at the same Sun angle.

Since launch in July, 1972, ERTS–1 has radioed back more than 100,000 pictures showing all the U.S. repeatedly and three-fourths of the world's land masses and coastal areas.

Pictures and data on magnetic tape have been provided to more than 300 investigators in government agencies, universities, and private companies in the U.S. and 37 other countries, and put on public sale.

The repetitive multispectral imagery of Earth taken by ERTS–1 has proved useful for such wide-ranging practical purposes as:

- Monitoring urban development and planning future land use;
- Identifying crops and estimating acreage;
- Locating air and water pollution;
- Mapping strip-mine and forest-fire scars;
- Locating geologic formations that may indicate the presence of minerals and petroleum;
- Updating maps and navigation charts.
- Measuring snow cover and monitoring the advance of glaciers;
- Studying flood hazards and managing water resources;
- Helping to locate underground water supplies.

A second ERTS is scheduled for launch early in 1975. Its data and the continued flow from ERTS–1 will be used in investigations in 43 U.S. states and 48 foreign countries by 104 research teams in federal, state and foreign governments, international organizations, universities, and private companies.

While ERTS was operated by remote control from the Goddard Space Flight Center in Maryland, a wealth of additional Earth resources data was collected by three successive astronaut crews in the U.S. experimental space station, Skylab.

Six high-resolution camera systems and advanced electronic sensors of Skylab's Earth Resources Experiment Package (EREP) acquired data in the form of 40,000 pictures and 70,300 m (238,000 feet) of magnetic tape on 440 test sites in the U.S. and 39 other countries.

ERTS and EREP data were supplemented by closer looks at Earth by more than 300 flights of NASA's seven Earth observations aircraft.

AERONAUTICS AND SPACE TECHNOLOGY

NASA aeronautical programs this year continued to attack problems of aircraft noise and pollution, to enhance safety, to improve the efficiency and operational economics of aeronautical flight, as well as to study and develop technology for future generation aircraft.

One area of progress was the successful testing of a modified refanned JT8D jet engine to provide technology to quiet present-day jet aircraft. Flight testing will begin early next year. The modified engine could reduce the ground areas affected by objectionable noise by 75 percent or more.

Another effort at reducing noise levels is the recently developed two-segment approach, which with a DC–8 transport achieves a 53 percent reduction in the area impacted by noise. A United Airlines DC–8 this year became the second aircraft in regular airline service to use the steeper landing approach procedures to reduce aircraft noise levels on the ground near communities.

Late this year NASA initiated a study expected to aid scientists in determining effects of jet exhaust products on the Earth's atmosphere. Data will be obtained from the atmosphere by using sampling equipment installed aboard several Boeing 747 jets.

A research program to study problems such as aircraft noise, airway and airport congestion, safety during low visibility operations and more efficient operations was started, using a specially equipped Boeing 737.

In an effort to make U.S. civil aviation less dependent on conventional petroleum supplies, NASA is investigating the effects on aircraft engines of fuels derived from oil shale and coal. The study will also check whether jet engines and fuel systems can operate satisfactorily on hydrocarbon fuels refined to less stringent specifications.

Testing began late this year on a new general aviation wing called the GAW–1. A derivative of the supercritical wing, potentially it could increase cruise efficiency for general aviation aircraft.

Flight evaluation of a boron-epoxy composite reinforced wing mid-section aboard two C–130 cargo planes was begun under a joint NASA/USAF program. Composite reinforced structures could lead to lighter, stronger and longer-lasting aircraft.

Airframes were crashed under carefully controlled conditions as part of a NASA/FAA program aimed at developing structural design techniques to improve the ability of light general aviation aircraft to withstand crashes and limit passenger injury.

NASA is investigating techniques to help alleviate air traffic congestion caused by aircraft wake-vortices—hazardous cylinders of rapidly spiraling air that trail from the wing tips of moving aircraft. Vortices can interfere with smaller aircraft flying too close behind larger aircraft.

NASA has developed a mainshaft seal for turbine engines capable of reducing wear, maintenance, and fuel consumption. Known as the self-acting lift-pad seal, it operates under severe conditions where conventional rubbing contact seals would fail.

On March 5, the esperimental NASA/USAF X–24B made its first supersonic flight. The X–24B is the successor of the wingless lifting bodies that were flown in a joint NASA/USAF flight research program to demonstrate man's ability to maneuver and safely land a vehicle with a shape designed for re-entry from space flight.

Incorporating what is termed "bubble technology," NASA developed a working model of a solid-state data recorder with no moving parts. Solid-state recorders offer high reliability and may replace magnetic tape recorders aboard spacecraft in the 1980s.

A significant breakthrough in developing a technique that could lead to more compact and reliable data systems in computers was made by scientists working under contract to NASA. The new technique uses organic materials whose chemical reactions can be manipulated by low power lasers to produce phase holograms. Each hologram will hold 100 million pieces of information per square centimeter.

Work continued this year on a solar electric propulsion stage (SEPS), one of several concepts under consideration for the application of solar electric propulsion for space vehicles. SEPS is designed to be compatible with the Space Shuttle and Space Tug.

Fission energy from a nuclear reactor was successfully converted directly into laser light for the first time in experiments sponsored by NASA which could lead to major advances in energy conversion, long-range communications and power transmission over long distances.

Another first for NASA occurred in October when a restartable solid fuel rocket motor was successfully test fired. It marked the first time a spacecraft-type solid fuel motor has been fired, quenched, re-ignited and requenched. This motor concept could reduce costs for missions requiring two distinct burns, a capability not previously available with low cost solid-fuel propulsion.

Scientists at the JPL have assembled a "breadboard" robot equipped with metal arms and hands, a visual system of two TV cameras and a laser, wheels for legs, and a computer brain programmed with thousands of instructions to provide a measure of "artificial intelligence" for unmanned planetary investigations.

Eventually, similar robots may be put to work on Earth in environments hostile to man, such as mining the sea bottom, working in a radio-active environment, or fighting fires.

TECHNOLOGY UTILIZATION

The year 1974 was one of the most active ever in the 12-year history of NASA's Technology Utilization Program. The program is designed to speed the transfer of potentially useful space-developed technology into other fields of human activity.

Space technology is now recognized as an invaluable national resource. Its additional use by government and industry for down-to-Earth applications gives American taxpayers an added bonus on their original space investment.

During 1974, the Technology Utilization Program:

- Catalogued almost 1,500 new examples of aerospace innovations and techniques;
- Published and distributed to more than 15,000 regular subscribers in the nation's business and industrial community more than 300 new Tech Briefs and 30 special compilations reporting specific items of new technology with possible commercial application;
- Carried out an extensive engineering applications program out of more than 70 projects to apply space technology techniques and innovations to help solve public sector problems;
- Served more than 4,000 clients through its nationwide network of Regional Dissemination Centers—an increase of 34 percent over last year.

As the year ended, two important long-range programs were being realized. The first was the start of field demonstrations by the Houston Fire Department of the NASA-developed firefighters' breathing system. This device features a lightweight oxygen bottle made of spiral-wound glass fiber over an aluminum liner similar to the bottles used for solid-propellant rocket motors. Its lighter weight and long-duration oxygen capacity make it more efficient than conventional units. Early next year the fire departments of New York City and Los Angeles will conduct similar on-the-scene field demonstrations. Commercial production of the new system is expected to start during 1975.

Another end-of-the-year milestone was installation of NASA-developed flat electrical cable in six apartments at a housing complex in Yonkers, NY. This marked the first time flat cable has been used to wire private dwellings. The cable is mounted in a snap-on baseboard developed at Marshall Space Flight Center. Its thinness and economy of installation make it ideal for both new housing and building renovations. Cooperating with NASA on the project is the New York Urban Development Corp.

Other highlights of the year included:

- Appointment of NASA technologists to work full-time with the City of Baltimore and the State of Illinois to help apply space technology to solving urgan-related problems;
- Development of a white blood cell freezing device for the National Cancer Institute to aid in the treatment of leukemia patients;
- Adapting tiny space-developed sensors and telemetry communications to study walking patterns of children suffering from cerebral palsy;
- Demonstrations of a number of control devices to allow bed-ridden patients to be more self-sufficient;
- Adapting NASA-developed hazard-analysis and quality control techniques to make offshore oil operations safer and more efficient.

INTERNATIONAL AFFAIRS

International cooperation increased in scope and complexity in 1974, with foreign nations providing substantial funding for several major joint ventures in space.

In December, Helios, the largest scientific satellite ever launched as a cooperative project by two nations, began its journey along a path that will carry it into the outer edge of the solar corona less than 30 million miles from the Sun.

This spacecraft, the first of two built by the Federal Republic of Germany, carries hardware for a dozen experiments on the space environment near the Sun. Total cost of the program is $260 million, with the German Ministry for Research and Technology providing $180 million of that total.

Helios was one of six international satellites launched by NASA in the final two months of 1974. The others included an Intelsat IV international communications satellite, Spain's Intasat ionospheric research satellite, and the OSCAR 7 amateur radio relay satellite.

In a November speech, Secretary of State Henry

Kissinger announced to the World Food Conference in Rome that three U.S. agencies would cooperate in an experiment to estimate crop yields using the Earth Resources Technology Satellite (ERTS).

The Large Area Crop Inventory Experiment, a joint effort by NASA, the Department of Agriculture and the National Oceanic and Atmospheric Administration will concentrate on wheat grown in North America at the outset. If this is successful, it will be extended to other parts of the world and other crops in succeeding years.

Investigators in some 40 nations agreed this year to fund new or continuing studies using data from ERTS satellites. Their proposals were selected by NASA along with more than 70 from U.S. investigators to provide extensive analysis of the satellites' usefulness for a wide range of studies in agriculture, forestry, land-use planning, pollution monitoring, water resources management and many other areas.

During the year, Italy and Iran signed agreements to build—at their expense—ground stations to receive data directly from the ERTS satellites. Similar facilities are already in operation in Brazil and Canada, offering support to the three U.S. ERTS stations in Alaska, California and Maryland.

The European Space Research Organization (ESRO) awarded the prime contract for the development of Spacelab in early June. Spacelab is a re-usable laboratory to be carried in the cargo bay of the Space Shuttle now under development by NASA.

The $226 million contract with Germany's VFW-Fokker ERNO provides for the delivery of a single flight-ready unit in early June. Total investment by Europe in the program is expected to exceed $400 million under the cooperative agreement signed in 1973.

The first international manned spaceflight, planned by the United States and the Soviet Union for July, 1975, proceeded on schedule during the year.

The study of the upper atmosphere was advanced through cooperative satellites launched with Italy (San Marco C–2) and Germany (Aeros–2) this year. Astronomy satellites were also launched in cooperation with the Netherlands (Netherland's Astronomy Satellite) and with the United Kingdom (UK–5). NASA's new Synchronous Meteorological Satellite, placed in orbit May 17, provided essential data for weather studies of the tropical Atlantic Ocean as part of the 66-nation Global Atmospheric Research Program.

ENERGY PROGRAMS

NASA is applying its long experience in the aeronautics and space sciences to help meet energy needs on Earth.

In May, NASA appointed former scientist-astronaut Dr. Harrison H. Schmitt (Apollo 17 Lunar Module Pilot) as Assistant Administrator for Energy Programs. The new office is responsible for coordinating NASA support to other Federal agencies conducting energy research and development. It also manages NASA programs applying aeronautics and space technology to the generation, transmission, storage, conservation, utilization and management of energy in non-aerospace applications.

Major advances toward low-cost, continuous production of solar cells, which convert sunlight directly into electricity by photovoltaic action, were made this year by a university-industrial team working under a jointly funded NASA/National Science Foundation program. The team developed a way of obtaining silicon ribbons by growing crystals directly in ribbon form, which may eliminate the present costly process of sawing thin wafers from large cylinders of single crystal silicon.

In another effort, engineers at NASA's Marshall Space Flight Center are demonstrating a system which will take from the Sun three-fourths of the central energy needed to heat and cool a simulated home.

In a related program, NASA has broken ground for a 53,000-square-foot engineering building at Langley Research Center for which solar energy will provide a significant part of the office building's heating and cooling.

Solar collectors used in the Marshall and Langley projects will test a thermal coating that absorbs over 90 percent of the solar energy striking it and re-emits only 5 to 6 percent.

NASA, in conjunction with NSF, began work this year on a project designed to determine the performance, operating and economic characteristics of wind-driven systems to generate commercial electric power.

Another NASA program is experimenting with the use of hydrogen to reduce pollution and increase efficiency in internal combustion engines such as those in automobiles.

Two joint NASA, Department of Transportation studies, aimed at reducing fuel consumption in cars and large trucks, began during the summer.

NASA is involved in other energy-related research and development programs. Some of these involve energy transmission and storage while

others deal with energy and environmental conservation. Others involve fuel conservation in aeronautics and remote sensing for detection of energy resources.

TRACKING AND DATA ACQUISITION

This year, the 64-meter (210-foot) antenna at Goldstone, CA, was used to conduct the first successful radar probe of Saturn. The probe indicated that the planet's distinctive rings may be composed of large chunks of solid material in orbit like a swarm of tiny moons. Previously scientists had thought that the rings of Saturn were made of gas, ice, dust or some combination of these.

Several outstanding accomplishments were made in the area of planetary mission tracking, including, through the use of S- and X-Band charged particle calibration, corrections to the 10-centimeter level with the Mariner 10 spacecraft.

Deep Space Network personnel also successfully demonstrated clock synchronization between Goldstone and Madrid to one-half micro-second resolution using quasars as a signal source. Together with dual station tracking, this timing accuracy is needed to meet future mission requirements.

Work was essentially completed on studies and technology development for the Tracking and Data Relay Satellite System (TDRSS) early this year. The TDRSS will use specially designed communications satellites in synchronous orbit to relay data between low altitude mission spacecraft and a single ground station located in the United States, replacing several existing ground stations, particularly those overseas. It will also provide nearly continuous access to future manned and unmanned spacecraft.

The Spaceflight Tracking and Data Network (STDN) provided tracking and data acquisition services to more than 40 individual space flight projects. The Network supported all NASA Earth orbital missions and a variety of space projects conducted by other government agencies and foreign countries.

Data were continuously recorded from five separate Apollo Lunar Surface Experiment Packages (ALSEP) left on the Moon by Apollo astronauts and from the Radio Astronomy Explorer (Explorer 49), launched in June. The Explorer spacecraft was placed in lunar orbit to measure galactic and solar radio noise.

Three tracking stations were augmented to accommodate new radio frequencies and spacecraft experiment data from the Applications Technology Satellite (ATS–6).

The Deep Space Network (DSN) provided nearly continuous support to the Pioneer 10 and 11 missions. The Pioneer 6 through 9 spacecraft, all in the extended mission phase, and radio science tasks were also supported on a time available basis.

NASA's tracking and data acquisition capability was increased significantly in 1974 as two 64-meter (210-foot) diameter antennas became operational. These are updated versions of the highly successful 64-meter antenna at Goldstone. One of the new antennas is in Spain, near Madrid, the other in Australia, near Canberra.

EQUAL OPPORTUNITY PROGRAMS

Substantial progress has been made in NASA's equal opportunity mission.

A detailed breakdown of employment statistics for the nine-month period from Jan. 1 through Sept. 30 showed a 12.1 percent increase in the minority workforce at the agency, while at the same time there was 2.7 percent reduction in NASA's overall workforce.

Of new persons hired, 24.6 percent were minorities. Women accounted for 46.1 percent of the new persons hired.

In the same period, 13.4 percent of persons who were graduated from non-professional to professional status at NASA were minorities. Of those upgraded, 44.6 percent were women.

In April, NASA launched the National Aerospace Fellowship program to encourage women and minority group members to seek careers in engineering and science and employment with NASA and the aerospace industry.

In addition, NASA is beginning to increase its research grants to colleges and universities with predominantly minority enrollment.

LAUNCH RECORD

NASA scored 15 successes in its 17 launch efforts during 1974.

Following up the failure of the first launch of the year, Skynet II-A aboard a Delta vehicle, was a string of six successful Delta Launches.

These included two domestic communications satellites for Western Union (Westars A and B); a meteorological satellite for the National Oceanic and Atmospheric Administration, ITOS–G; Skynet II–B for Great Britain; a Synchronous Meteorological Satellite (SMS–A); and Symphonie, a French-German communications satellite.

Atlas Centaur was used only once in 1974, to successfully orbit an Intelsat IV communications satellite for the Comsat Corp.

The Titan IIIE/Centaur successfully launched Helios-A, a U.S.-German cooperative spacecraft venture to obtain new information on interplanetary space near the Sun.

The only other launch using Centaur as an upper stage was the Titan IIIE/Centaur launch of a Viking development test vehicle in February—a failure because the Centaur stage did not burn as programmed.

Titan III-C was used for the successful launch of the ATS-6 applications technology satellite in May.

The small and only all solid-propulsion vehicle in NASA's launch stable, Scout, was used six times in 1974. It launched three reimbursable scientific satellites: the UK X-4 for Great Britain, the ANS scientific satellite for The Netherlands and the AEROS-B for West Germany.

Scout successfully launched two cooperative missions: the Italian San Marco-4 spacecraft and Britain's UK-5. It was also used to launch NASA's Hawkeye scientific satellite.

LUNAR SAMPLE EXHIBITS

The following is a schedule of lunar sample exhibits from Jan. 15, 1975, to Feb. 15, 1975:

CALIFORNIA—Open House Science Exhibit, Los Medan's College, Pittsburg, Jan. 13–17.
COLORADO—American Numismatic Association, Colorado Springs, Jan. 18.
NEW JERSEY—Science Teachers' Association Conference, Jersey City, Feb. 3–7.
NORTH CAROLINA—Community Impact, Morehead Planetarium, Chapel Hill, Jan. 13–26.
TEXAS—Houston Museum of Natural Science/History, End of Caroline at Hermann Park, Houston, Jan. 15–Feb. 15.

Permanent Displays

ALABAMA—Alabama Space and Rocket Center, Marshall Space Flight Center, Huntsville.
FLORIDA—Vistor Information Center, Kennedy Space Center.
KANSAS—Eisenhower Library, 200 SE 4th Street, Abilene.
NEW YORK—United Nations Building, New York City.
OHIO—U.S.A.F. Museum, Wright Patterson AFB.
TEXAS—Johnson Library, University of Texas, Austin; Visitor Information Center, Johnson Space Center, Houston.
VIRGINIA—Visitor Information Center, Langley Research Center, Hampton.
WASHINGTON, DC—National Geographic Museum; Smithsonian Institution, National Air and Space Museum, 1000 Jefferson Drive.

NEW NASA PUBLICATIONS

, THE NEW MARS is a highly illustrated, 179-page review of the discoveries of Mariner 9, prepared for the Office of Space Science by William K. Hartmann and Odell Raper with the cooperation of the Mariner 9 Science Experiment Team. It clearly describes the growth of knowledge about Mars, the encounter with the great dust storm in 1971, and findings about the planet's atmosphere, geological features, and the moons Phobos and Deimos. Hardbound copies (Stock No. 3300-00577) may be purchased for $8.75 from the Superintendent of Documents, Government Printing Office, Washington, DC 20402. (SP-337).

SKYLAB is a full-color, 64-page summary of the three manned missions to the nation's first experimental space station and was reprinted from the October, 1974, National Geographic magazine expressly for NASA. It is available at Headquarters and Center Public Information and educational offices. (EP-124).

OUR PRODIGAL SUN pulls together some of the latest information about that churning, ever-changing ball of hot gases that assures life on Earth and may, in time, be tapped as a significant energy supplier. The 14-page booklet is available at the U.S. Government Printing Office for 35 cents per copy. (EP-118).

THE JUPITER PIONEERS is a full-color, foldout wallsheet describing how the spacecraft explore Jupiter and the initial Pioneer findings and photography of the huge, gaseous planet. It is available at the U.S. Government Printing Office for 60 cents per copy. (NF-50).

NASA AERONAUTICS is a full-color foldout wallsheet describing how ideas become technology and some of the major NASA efforts towards improving civil and military aviation. It is available at the U.S. Government Printing Office for 50 cents per copy. (EP-46).

HEADQUARTERS PRESS RELEASES

(Issued by the Public Information Division, Code FP, Headquarters, Washington, DC 20546. These releases are available only to members of the news media.)

74-314 Helios Press Kit
74-315 Scientists Uncover Clue to Io's Glitter
74-316 Symphonie Press Kit
74-317 Global Air Sampling Program Exercise Begins
74-318 Advanced Swing-Wing Aircraft Shows Promise
74-319 NASA Scientist Develops New Coating for Salt Lenses
74-320 Houston firemen Get NASA-Developed Light Weight Breathing Gear
74-321 Telemetry System on Satellite Reactivated
74-322 Amateur Radio Satellite Offers Help to Science Teachers
74-323 Whitcomb to Be Awarded 1974 Wright Brothers Trophy
74-324 Key Personnel Changes Announced at NASA Headquarters
74-325 NASA and Electric Power Institute Sign Memo of Understanding
74-326 Student Emblem to Be Selected for Viking Lander
74-327 Future Soviet Biological Satellite to Carry U.S. Experiment
74-328 Women Experimenters in Simulated Space Test Experiment at MSFC
74-329 ERTS-B Press Kit
74-330 Highlights of 1974 Activities
74-331 Scherer Named KSC Director
74-332 Floating Aquatic Plants Remove Chemicals from Polluted Water

NASA TECH BRIEFS

(The Technology Utilization Office; NASA Headquarters)

(The following is a listing of published NASA Tech Briefs. Inquiries concerning them should be directed to the TU Office at the originating NASA Center.)

Innovator(s)	*Title*	*Number*	*Center*
R.J. Hendel, T.F. Jamba, Jr., G.E. Keefe and L.L. Rosier, IBM Corp.	Permalloy Patchwork Improves Bubble-Domain Memory Device	MFS–22116	MSFC
G.S. Almasi and G.E. Keefe, IBM Corp.	Compact Decoder for Bubble-Domain Memories	MFS–21914	MSFC
G.S. Almasi and G.E. Keefe, IMB Corp.	Bias-Field Equalizer for Bubble-Domain Memories	MFS–21913	MSFC
G.S. Almasi and L.L. Rosier, IBM Corp.	Thermal Control of Operating Margins in Bubble-Domain Memory Devices	MFS–22115	MSFC
G.S. Almasi, G.E. Keefe and L.L. Rosier, IBM Corp.	Edge Effect Improves Bubble-Domain Memory Devices	MFS–22114	MSFC
R.D. Hilborn, Rockwell International Corp.	Modification of Implicit ARC Tangent Generation for Continuous Rotation	MSC–17315	JSC
D.G. Ferneyhough, Jr., and C.T. Landers, IBM Corp.	Special-Purpose Conical-Span/Straightener Device: A Concept	MFS–22718	MSFC
Roman Krawec, LeRC	Abel-Inversion Computation	LEW–10879	LeRC
A.L. Recksiedler, Sperry Rand Corp.	Repeated Single-Error Correction Capability	MFS–22332	MSFC
David F. Parker, Martin Marietta Corp.	Time-Code Translator	GSC–11218	GSFC
R.R. Peck, Rockwell International Corp.	Automatic Lamp Changer	MSC–15745	JSC
W.J. Wong, Rockwell International Corp.	High-Current Overvoltage Detector and Voltage-Limiter Circuit	MSC–19219	JSC
Aubrey J. Butts, Martin Marietta Corp.	Thermoelectric Low-Frequency DC Isolator: A Concept	LAR–11102	LaRC
Russell J. Jirberg, LeRC	Automatic Distortionless Control of Magnetic Field Modulation	LEW–10953	LeRC
A.D. Ciccanti and R.J. Tallent, The Boeing Co.	Watt-Hour and Ampere-Hour Meters	MSC–11837	JSC
R.J. Lipin, Sperry Rand Corp.	Coaxial Switch Life-Test Controller	MFS–22336	MSFC
B. Bregman, Martin Marietta Corp.	Four-Quadrant Multipliers Generate Series Expansion of Sinusoidal Functions	MSC–13908	JSC
R.V. Franklin, Sperry Rand Corp.	Peak-Power Tracker Circuit	MFS–22267	MSFC
D.L. Trower, McDonnell Douglas Corp.	Silicon-Controlled (SCR) Protection of Relay Contacts	MFS–22444	MSFC
D.L. Pippin, JSC, and L.A. Chavez, Service Technology Corp.	Pneumatic-Impact Solenoid-Valve Driver and Timer	MSC–13623	JSC
Melvin M. Hintze, Martin Marietta Corp.	Amplifierless Demodulator	LAR–10758	LaRC
Edward A. Maslowski, LeRC	Operational Amplifier Eliminates Diode Forward-Voltage Drop	LEW–10716	LeRC
Stanley J. Rusk, Lockheed Missile & Space Co.	Pulse-Excited Bolometer	ARC–10292	ARC
C.E. Whaley, Sperry Rand Corp.	5-Volt Command Trip-and-Hold Circuit	MFS–22682	MSFC
Eastman Kodak Co.	Electromechanical Event-Sequencing System	MSC–13620	JSC
E.A. Howard and G. M. Hotz, JPL	Expandable Mast Used in One-Shot Soil Penetrometer	JPL–00685	JPL
W.R. Hutchinson, Martin Marietta Corp.	Nondestructive Test for Fine Cracks and Porosity in Solder Joints	MFS–21065	MSFC
A.J. Yorgiadia, L.J. Allison and A.J. Webber, Rockwell International Corp.	Vibration Amplification Fixture with Linear Motion	MFS–24018	MSFC
W.G. Boyd and H.L. Pontius, Rockwell International Corp.	Measuring Mechanical Strain Induced by Thermal Contraction	MFS–24150	MSFC
T.L. Sullivan and C.C. Chamis, LeRC	Gripping Technique for Fiber/Matrix Composite Tubes	LEW–11798	LeRC

NASA TECH BRIEFS—Cont.

Innovator(s)	*Title*	*Number*	*Center*
B.J. Rosenbaum, M. Oberschmidt and J.J. Fitzgerald, JSC	Flow-Test Device Fits into Restricted Access Passages	MSC–01078	JSC
F. Stuckenberg, Rockwell International Corp.	Nondestructive Structural Crack Detection	MSC–17455	JSC
J.C. Newland, J. Derbyshire, Jr., W.G. Boyd and E. G. Stevens, Rockwell International Corp.	Determination of Residual Strain in Metal-Sheathed Wire	MSC–17667	JSC
R.B. Brown, Areojet-General Corp.	Expendable Rubber Plug Seals Openings for Pressure Testing	NUC–00048	SNSO
R.D. Bryant, Rockwell International Corp.	Quality Control Criteria for Acceptance Testing of Cross-Wire Welds	MSC–627	JSC
F.D. Griffin, KSC	Gauge Tests Tube Flares Quickly and Accurately	KSC–66–19	KSC
J.S. Fritzen, Lockheed-California Co.	Laboratory Fracture Penetration Detector	MSC–14290	JSC
E.F. Vandergrift, Westinghouse Corp.	Self-Aligning Rod Prevents Eccentric Loading of Tensile Specimens	NUC–10525	SNSO
Hughes Aircraft Co.	Vibration Tests on Vidicons Made by Improved Method	JPL–SC–115	JPL
G.A. Tuthill, Rockwell International Corp.	Power Utility Checkout Kit	MSC–15770	JSC
A.W. DiMarzio, RCA Corp.	High-Frequency T Network	MSC–12203	JSC
E.L. McCormick, Martin Marietta Corp.	Receiver-Gain Stabilization System	GSC–10641	GSFC
C.P. Jones, The Boeing Co.	"In-Place" Relay Tester	KSC–10367	KSC
J.M. Lambert and H. Bulger, LeRC	Apparatus for Testing over a Wide Range of Cryogenic Temperatures	LEW–11596	LeRC
F.H. Meissner, Brown and Root-Northrop Corp.	Pressure Control System to Test Cryogenic Storage Vessels	MSC–13847	JSC
F.H. Stuckenberg, Rockwell International Corp.	Video Recording of Holographic Patterns	MSC–17525	JSC
F.H. Stuckenberg, Rockwell International Corp.	Multiple Sequence for Holographic Interferometric Nondestructive Testing	MSC–17523	JSC
H.L. Hillbrath and W.P. Dill, The Boeing Co.	Measurement Technique for Nozzles and Venturis	MFS–15304	MSFC
James N. Deyo and Donald G. Beremand, LeRC	Measuring Device for Ring-Dimpled Tubes	LEW–10392	LeRC
M.N. Gardos, Hughes Aircraft Co.	Ultrahigh-Vacuum Quartz-Spring Microbalance	MFS–22415	MSFC
Harry W. Dayton, LaRC	Simultaneous Multimeasuring Caliper Standard	LAR–11114	LaRC
Houston D. McGinness, Caltech/JPL	Small-Angle Adjustment, Without Preload Release	NPO–10744	NPO
J.H. Kimzey, JSC	Wrench Selection Gauge	MSC–12590	JSC
Bruno Drescher, The Boeing Co.	Functional Checkout of Cryogenic-Storage-Tank Shutoff Valves	KSC–10155	KSC
Laurence J. Bement, LaRC	Pyrotechnic Performance Monitoring	LAR–10800	LaRC
E.F. Green, Rockwell International Corp.	Portable Hardness Tester	MFS–19167	MSFC
G.A. Hood and F.A. Raniere, Rockwell International Corp.	High-Pressure-Oxygen Impact Tester	MFS–19162	MFSC
G.H. Burow and F.A. Hunter, Rockwell International Corp.	Burst Energy Reduced During Pressure Tests: A Concept	MFS–19154	MSFC
W.E. Wiley, Rockwell International Corp.	Vent Line Relief-Valve Fitting: A Concept	MSC–17783	JSC
R.A. Bender, Rockwell International Corp.	Support Clamp for Tube Assembly Testing	MSC–17603	JSC
G.R. Taylor, McDonnell Douglas Corp.	Pressure-Test Adapter for Unfinished Tubing	MFS–21439	MSFC
M.L. Tanzer, Hoffman-La Roche, Inc.	Liquid-Crystal Tape for Thermographic Testing of Bonded Structures	MFS–22441	MSFC
E.J. Skolka and E.B. Cutright, GSFC	Safety Guard for Fork-Life Truck	GSC–11751	GSFC
Leo Berner, Aerojet-General Corp.	Pipeline Bolt-and-Nut Trap	LEW–90558	LeRC
P.J. Bergmann, Jr., and J.F. DeBold, McDonnell Douglas Corp.	Tank Mounting System	MFS–22374	MSFC

NASA TECH BRIEFS—Cont.

Innovator(s)	*Title*	*Number*	*Center*
R.E. Altenbach, Rockwell International Corp.	Concepts for Transferring Hazardous Fluids Safely	MSC–17968	JSC
L.D. Menges, McDonnell Douglas Corp.	Radiographic-Source-Tip Stand	MFS–22421	MSFC
P.J. Rossi, Rockwell International Corp.	Toggle Switch Safety Guard	MSC–15638	JSC
R.E. Brady, Rockwell International Corp.	Predicting Crack Propagation in Pressurized Lines	MFS–24053	MSFC
K.R. Hubbs, Rockwell International Corp.	Overpressure Safety Cap for Helium Leak Detector	MSC–17172	JSC
Henry M. Waddell, Jr., Rockwell International Corp.	Coverall Safety Straps for Personnel Rescue	KSC–10815	KSC
F.M. Hoog, Trans World Airlines	Gas Charging of Oil-Filled Breaker Switches	KSC–09981	KSC
J.F. Schuessler and R.L. Photon, McDonnell Douglas Corp.	One-Step Explosive Forming of Metal: A Process Improvement	MFS–22585	MSFC
Edgar Kauffman, Robert Hessler and Dott Wells, GSFC	Grinding Wheel Dresser	GSC–11140	GSFC
Max D. Musgrove, The Boeing Co.	Break-Formed Structural Panels	LAR–11171	LaRC
Charles Fleetwood, Jr., GSFC	Control Polishing Glancing-Incidence Optics	GSC–11781	GSFC
Charles Fleetwood, Jr., and Charles Davis, GSFC	Zonal Contouring Using a "Dentist's-Drill" Polisher	GSC–11780	GSFC
W.R. Vaughn, Rockwell International Corp.	Stepover Chart for Ramping Cuts	MSC–17288	JSC
W.C. Brown, Raytheon Co.	Fabrication of Irregular Surface Shapes	MFS–22205	MSFC
Earl D. Ellis, GSFC	Metallic Masking for Electroplating	GSC–11203	GSFC
D.I. MacFarlane, Rockwell International Corp.	Protection from Hydrogen-Environment Embrittlement	MFS–19172	MSFC
Lawrence A. Mueller, Ernest A. Koutnik and Vincent R. Lalli, LeRC	Specially-Treated Stainless-Steel Screws for High-Temperature Use in a Vacuum	LEW–11176	LeRC
J.E. O'Tousa and F.T. Shuler, Rockwell International Corp.	Method of Rapidly Aging an Electrolyte	MFS–19178	MSFC
J. Addoms, R. Boyce and K. Gustafson, Aerojet Liquid Rocket Co.	Technique for Visual Inspection of Nickel-Plating Quality	MFS–21151	MSFC
Glenn M. Haskins, Caltech/JPL	New Process for Welding Bare-Junction Thermocouples to Refractory Metals	NPO–11435	NPO
F.T. Schuler and H.A. Tripp, Rockwell International Corp.	Electrodeposited Copper for High-Temperature Use	MFS–19173	MSFC
Gary H. Apple, The Garrett Corp.	Electron-Beam Welding on Dissimilar Metals	LAR–10802	LaRC
D.C. Rogers, LTV Aerospace Corp.	Reducing Sticking of Reacting Pack Material in a Pack Coating Process	MSC–14045	JSC
D.E. Necker and C.L. Byrd, Rockwell International Corp.	High-Reliability, Elastomer-Seal Installation	MSC–17474	JSC
K.W. Fee, Rockwell International Corp.	Adapter and Disposal Bag for Spray Guns	MSC–17177	JSC
S.H. Foster and K.H. Lothrop, Emerson & Cuming, Inc.	A New Potting, Sealing, and Conformal Coating System	MSC–13479	JSC
J.F. Wade, Martin Marietta Corp.	Application of a Soft-Anodizing Process for Optical Instruments	MFS–20365	MSFC
Margaret I. Alley and Allan D. Smith, LeRC	Glass Capillary Tube Cutter and Sealer	LEW–11899	LeRC
H. Birnbaum and J.W. Warren, Rockwell International Corp.	Reduction of Stiffness Requirements for Flat Frames	MSC–17789	JSC
Joseph Epstein, GSFC	Low-Resistance Contacts for Solar Cells	GSC–10695	GSFC
J.F. Burgess, R.F. Girard, C.A. Neugebauer and C.J. Watters, General Electric Co.	A Technique for Adding Solder Bumps to Integrated Circuit Chips	MSC–14402	JSC

NEW ENERGY AGREEMENT—Housing and Urban Development Secretary James T. Lynn and NASA Administrator James C. Fletcher sign a joint plan for implementing the Solar Heating and Cooling Demonstration Act of 1974.

PATENTS FOR INVENTIONS RESULTING FROM NASA RESEARCH

(The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel for the indicated installation.)

Inventor(s) and Employer	*Title and NASA Docket*	*Patent No.*	*Installation*
Michael Gedwill and Salvator J. Gresaffe, NASA/LeRC	Method of Protecting the Surface of a Substrate LEW–11,696–1)	3,849,865	LeRC
John A. Woollam, NASA/LeRC, and Harry A. Beale and Ian L. Spain, Univ. of MD	Hall Effect Magnetometer (LEW–11,632–2)	3,849,875	LeRC
Vernon D. Gebben and John A. Webb, NASA/LeRC	Circuit for Detecting Initial Systole and Dictrotic Notch (LEW–11,581–1)	3,850,169	LeRC
Clarence H. Heckler, Jr., Paul D. Baba and Nutan C. Bhiwandker, Ampex Corp., Redwood City, CA	Method for Making Conductors for Ferrite Memory Arrays (LAR–10,994–1)	3,849,877	LaRC
Dan H. Dane, NASA/MSFC	Orthotic Arm Joint (MFS–21,611–1)	3,849,668	MSFC
John W. Olcott, Edward Seckel and David R. Ellis, Aeronautical Research Associates, Inc., of Princeton, NJ	Integrated Lift/Drag Controller For Aircraft (ARC–10,456–1)	3,850,388	ARC
Robert M. Munoz, NASA/ARC	Continuous Fourier Transform Method and Apparatus (ARC–10,466–1)	3,851,162	ARC
Milton Winitz, Medical Science Research Foundation, San Mateo, CA	Reduction of Blood Serum Cholesterol (NPO–12,119–1)	3,849,554	NaPO
Wilbur C. Heier, NASA/LaRC	Evacuated Displacement Compression Mold	3,850,567	LaRC
John R. Hollahan and Theodore Wydeven, National Academy of Sciences, Washington, DC	Water Purification Membranes and Method of Preparation (ARC–10,643–1)	3,847,652	ARC
Klaus Heinemann, National Academy of Sciences	Electron Microscope Aperture System (ARC–10,448–2)	3,847,689	ARC

1975 LAUNCH SCHEDULE

Name	*Launch Date*	*Vehicle*	*Range*	*Mission/Remarks*
ERTS–B	Jan. 19	Delta	WTR	To assign, develop, and launch a series of spacecraft into medium altitude orbits for the purpose of conducting a variety of experiments in the Earth resources disciplines.
SMS–B	Jan. 30	Delta	ETR	Part of a global network of geostationary environmental satellites with the objective of providing Earth imaging in the visible and IR spectrums, monitoring space environment.
Comsat (Intelsat IV) F6	Feb. 6	Atlas-Centaur	ETR	Global commercial communications satellite system
Telesat-C	Mar. 6	Delta	ETR	Third of a series of Canadian Domestic Communication Satellites. Designed to transmit TV, voice, data. Reimbursable.
GEOS-C	Mar. 20	Delta	WTR	To demonstrate and calibrate satellite altimeter to absolute accuracy of 5m and relative accuracy of 1–2m; establish precision capability of satellite/satellite tracking; accomplish preliminary evaluation of altimeter-improved oceanic geoid. Support calibration of G-band radars.
Atmosphere-D	March	Delta	ERT	To investigate the photochemical processes accompanying the absorption of solar ultraviolet radiation in the Earth's atmosphere by making closely coordinated measurements of the reacting constituents from a spacecraft with onboard propulsion to permit variations of perigee.
OSO-1	March	Delta	ETR	Mission (1) to observe the active physical processes of the Sun by which the Sun influences the Earth and its space environment; and (2) to advance understanding of the Sun's constitution and behavior.
Comsat (Marisat)-A	April	Delta	ETR	Spacecraft is part of the first Domestic Communications Satellite (DCS) system.
Comsat (Intelsat IV) F-1	May	Atlas Centaur	ETR	Global commercial communications satellite system.
Nimbus-F	June	Delta	WTR	Weather and climate meteorological satellite for advanced global weather and atmosphere soundings.
Comsat (Intelsat IVA)-A	2nd qtr	Atlas Centaur	ETR	Global commercial communications satellite system.
Comsat (Marisat-B	2nd qtr	Delta	ETR	Spacecraft is part of the first Domestic Communications Satellite (DCS) system.
Small Astronomy Satellite SAS-C	2nd qtr.	Scout	SM	Communications technology satellite: cooperation of the U.S. with Canada for an experimental communications technology satellite to advance the state of the art in spacecraft and ground technologies.
ASTP	July 15	Saturn IB	ETR	First international manned space flight. American astronauts in Apollo spacecraft will link up with Russian cosmonauts in Soyuz spacecraft, the primary objective to conduct space experiments to test for compatibility of systems for future manned spacecraft and stations.
ITOS-E2	July	Delta	WTR	Operational meteorological satellite funded by NOAA; developed, launched, and operated initially by NASA.
European Space Research Org. (CDS-B)	July	Delta	WTR	The purpose of the COS-B mission is to study extraterrestrial gamma radiation in the energy range from 25 Mev to 1 Gev. (Reimbursable.)

1975 LAUNCH SCHEDULE—Cont.

Name	*Launch Date*	*Vehicle*	*Range*	*Mission/Remarks*
NATO-C	Aug.	Delta	ETR	Perform communications relay for NATO. (Reimbursable.)
Atmosphere-E	Sept.	Delta	ETR	To investigate the photo-chemical processes accompanying the absorption of solar ultraviolet radiation in the Earth's atmosphere by making closely coordinated measurements of the reacting constituents from a spacecraft with onboard propulsion to permit variations of perigee.
Comsat (Intelsat IVA)-B	3rd qtr.	Atlas Centaur	ETR	Global commercial communications satellite system.
French/Germany Symphonie-B	3rd qtr	Delta	ETR	A telecommunications mission between the French and German governments, the purpose of which is to launch two flight models of an experimental communications satellite for TV, telephone, and data transmission.
Viking A&B	3rd qtr.	Titan III Centaur	ETR	Two launches of a Viking spacecraft consisting of an orbiter and lander to orbit the planet Mars and separate a lander capsule which will enter the Martian atmosphere and soft land on the surface of Mars.
Dual Air Density	2nd half	Scout	WTR	To obtain global density measurements of the upper thermosphere and lower exosphere; obtain, simultaneously on a global scale, measurements of the composition of the Earth's upper thermosphere and lower exosphere; determine the vertical structure of the atmosphere as a function of latitude, season, and local solar time.
Cooperative Applications Satellite-C/ Communications Technology Satellite, CAS-C. CTS	4th qtr.	Atlas Centaur	ETR	Communications technology satellite: cooperation of the U.S. with Canada for an experimental communications technology satellite to advance the state of the art in spacecraft and ground technologies.
RCA-A	4th qtr.	Delta	ETR	To provide capability for TV, telephone, and data transmission over the continental United States (including Alaska) for established group stations.
Relativity	1975	Scout	WI	To measure the redshift of a hydrogen maser clock system as it traverses the range of gravitational potential from the Earth's surface to an altitude of 18,530 km to test the principle of equivalence which is a cornerstone of Einstein's Theory of Relativity.

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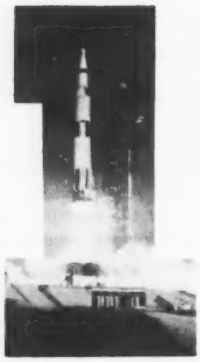
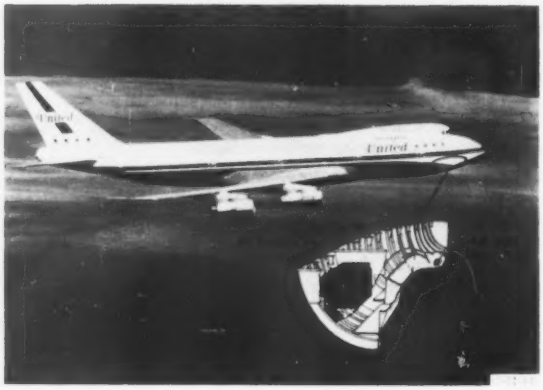


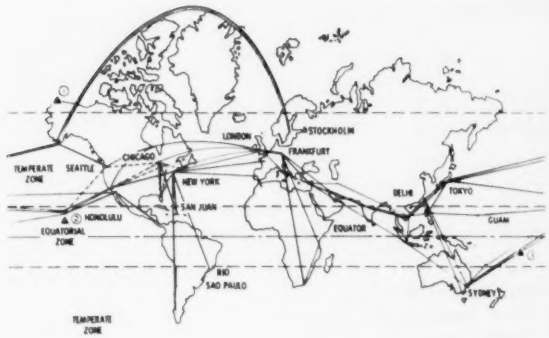
WORTH FROM SPACE?

FOR A PENNY OF YOUR TAX DOLLAR, YOU ARE GETTING, AMONG OTHER THINGS

GLOBAL AIR SAMPLING



GLOBAL AIR SAMPLING ROUTES



Under contract with NASA, a United Airlines 747 jumbo jet (left) from the San Francisco International Airport began in December what is to become a worldwide air sampling project by commercial aircraft scheduled to reach its peak in 1976

The 747 was equipped with special instruments to measure dust particles and gases in the upper atmosphere (20,000 to 40,000 feet). The survey will be made in the nation's airlanes on its regular flight routes, for operation of the air sampling equipment in no way interferes with normal flight activity. All readings are recorded by tape recorder.

The Global Air Sampling Program (GASP) is managed by Lewis Research Center. Data collected under it is expected to help determine to what extent, if any, emissions from jet aircraft, as well as other pollution sources, affect the Earth's natural atmosphere. It may also show whether the level of ozone, which shields out harmful ultraviolet solar radiation, changes from time to time and whether jet vapor trails contribute to cloud cover.

In addition to suspended particulates, the 747 initially will monitor carbon monoxide, ozone and water vapor. Other instruments will be added by next summer to monitor oxides of nitrogen, carbon dioxide, and condensation nuclei (extremely small dust particles, below .3 micron in size).

The program, as envisioned, will survey the airlanes of the world over a five to 10-year period. Three other air carriers will be added to provide the global coverage desired. A Pan American 747 will be outfitted with pollution detection instruments in February, 1975, and, late in the year, Quantas Airways of Australia will add one of its 747s. The Scandinavian Airline System will complete the GASP fleet in early 1976.

Information collected under the program will be made available by NASA to other government agencies and organizations interested in upper atmospheric pollution effects. Results of the study will be used by the National Oceanic and Atmospheric Administration to combine with weather data for assessment of environmental effects.

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AMERICAN REVOLUTION BICENTENNIAL 1776-1976